581-10

AIR LIGHT AND EFFICIENCY

AIR, LIGHT
and
EFFICIENCY

Showing Influence of Sash
Types and Building Design

DAVID LUPTON'S SONS CO.
Weikel and Westmoreland Streets
PHILADELPHIA

CHICAGO
NEW YORK

PITTSBURGH
CLEVELAND
WASHINGTON

BOSTON
DETROIT

SUPPOSE that—without prejudice to your markets or your sources of supply—your factory could be transported to Southern California.

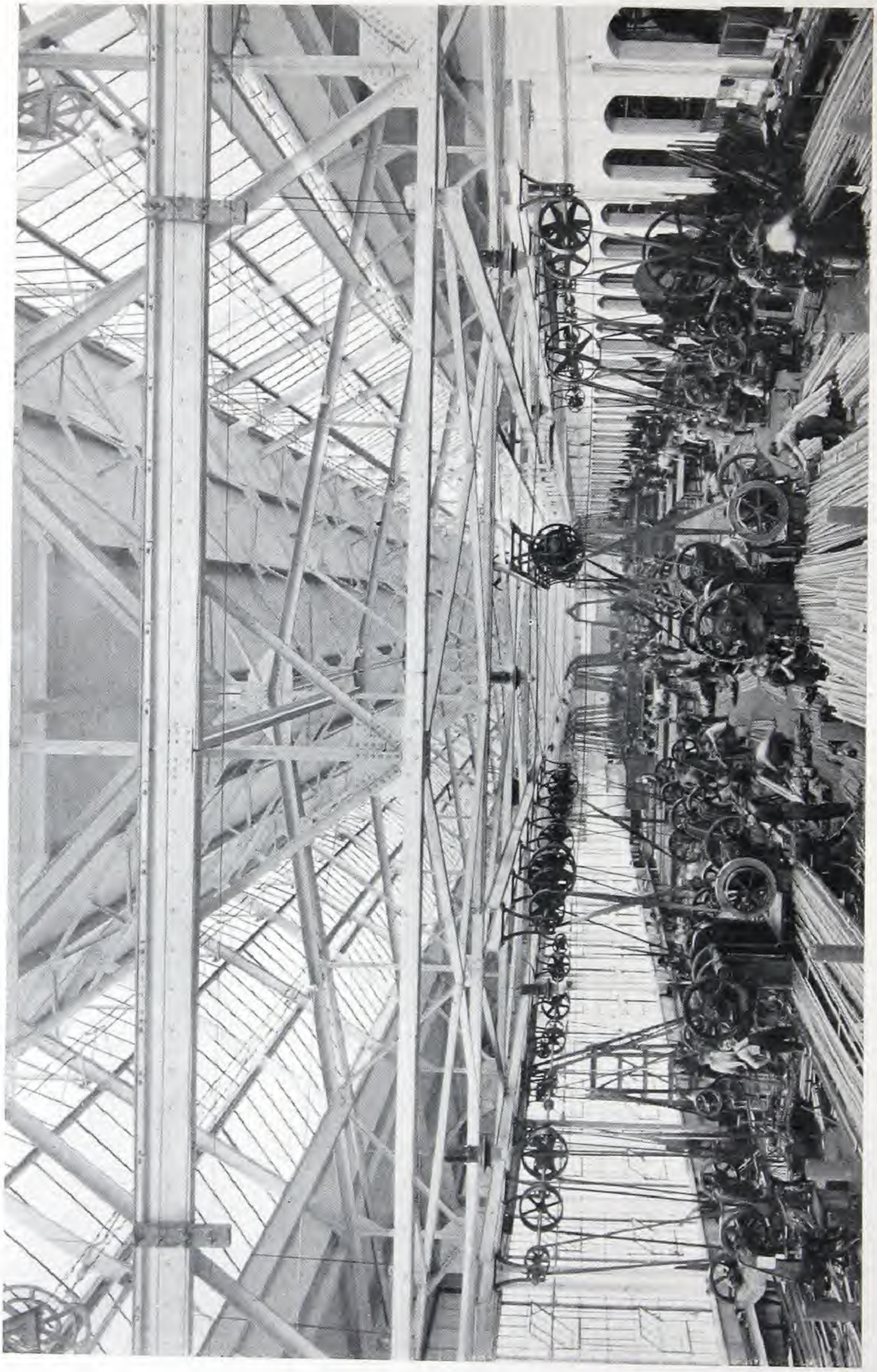
Imagine your work-benches, your lathes and milling machines, or your calenders and vulcanizers, set up in neat rows under the live oaks of Los Angeles, with the blue vault of heaven for light and the salt Pacific breezes for ventilation.

Wouldn't your production jump?

Wouldn't the dividend checks be bigger?

If we only stop to think of it, there isn't a man among us who doesn't realize that light and air have a profound physical influence. Who hasn't seen a boy or a dog race for sheer joy on a windy day, and felt the same skipping spirit within himself? What owner of a car doesn't know the tonic effect of sun and air?

But with all our feeling for out-doors, how slow we are to bring its essentials into industrial life! We shut out light by roofs and brick walls—and buy electricity. We shield ourselves from the blasts of winter—and half stifle with unopened windows; or we install costly blower systems to remove vapor, smoke and stale air that would remove itself naturally if we gave it a chance. We may not be able to go to California, but sunlight and fresh air are here, free to all, and it is our own fault if we don't use them!



Steel Sash Department of Lupton factory, showing abundant lighting with Pond Truss roof. Lines of weatherproof Pond Continuous Sash in the roof are opened as desired by Pond Operating Device and hand chains.

Modern streets don't grow from cow-paths

AIR, LIGHT AND EFFICIENCY

Human Conservation

Had the world war done nothing else, it has taught us that there is no place in modern life for inefficiency—for the mere blind following of habit.

If a certain job is done 50 per cent faster in a well-lighted, airy location than in a dark corner, we cannot afford to lose one-third of the worker's value by maintaining the dark corner. If the workers, earning more money with less strain in a factory where air and light are at their best, stay on their jobs two or three times as long, the saving in "hiring and firing" will more than repay the higher cost of the modern structure; and the added man-power available is a clear gain to the employer and the community.

Like better machinery, scientific management, and welfare work, so also modern factory design is a step toward human conservation and greater output with less effort.

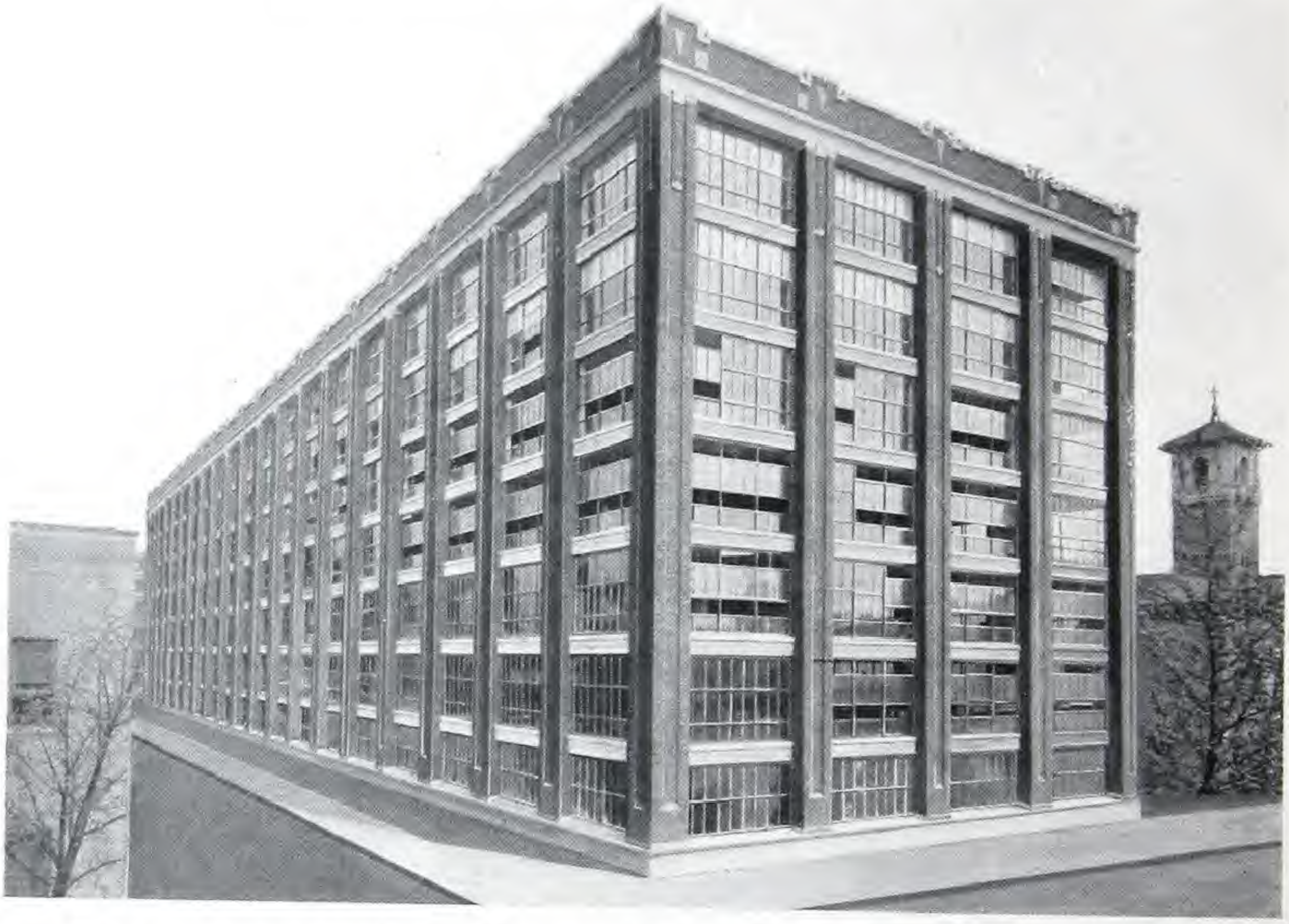
But what is modern factory design? Ideas have changed much on that point of late.

In a word, it is, for any given conditions, *the design which gets the maximum output from both men and machines at minimum cost.*

Such designs will vary widely according to the nature of the product, the skill required, the number of workers, the cost of land, and so on. Today certain definite relationships are recognized between the character of the work, the width and height of building, the height of ceilings, the heating and ventilating requirements, etc.

In a pattern loft, lubricant factory or paper mill, for example, the work is not exacting, and much floor space is needed for a few workers. Hence there may be a considerable percentage of wide floors with low ceilings and free use of artificial light. Such a factory may be several stories high, each floor having storage space or subsidiary work in the centre and the more exacting work near the windows.

A shoe, watch, or rubber factory, a machine shop or automobile factory, on the other hand, employs many workers per unit floor space, and their work must be both rapid and accurate. Such a factory, if of several stories, should be of limited width, with ceilings of sufficient height to allow plenty of light and air to reach the centre of the building. Badly lighted or ventilated areas, if tolerated at all, should be limited to what can be used for storage, movement of goods, and the coarser kinds of work.



Factory Building of the Dayton Engineering Laboratories Co., Dayton, O. Messrs. Schenck & Williams, Architects. Width of building 88 ft. To obtain maximum lighting effect stationary glass panels are set under Lupton Steel Sash, Counterbalanced Type. The strong panel effect between the pilasters is noteworthy.

Ventilation, in a building for such uses, demands much more than casual thought, else the central areas, even if sufficiently lighted, may get little air. If the building has several stories, equal top and bottom openings of the sash are essential to secure air movement on windless days. The familiar pivoted ventilators, located midway of the sash height, do nothing to encourage air

Ventilation in practice beats ventilation on paper.

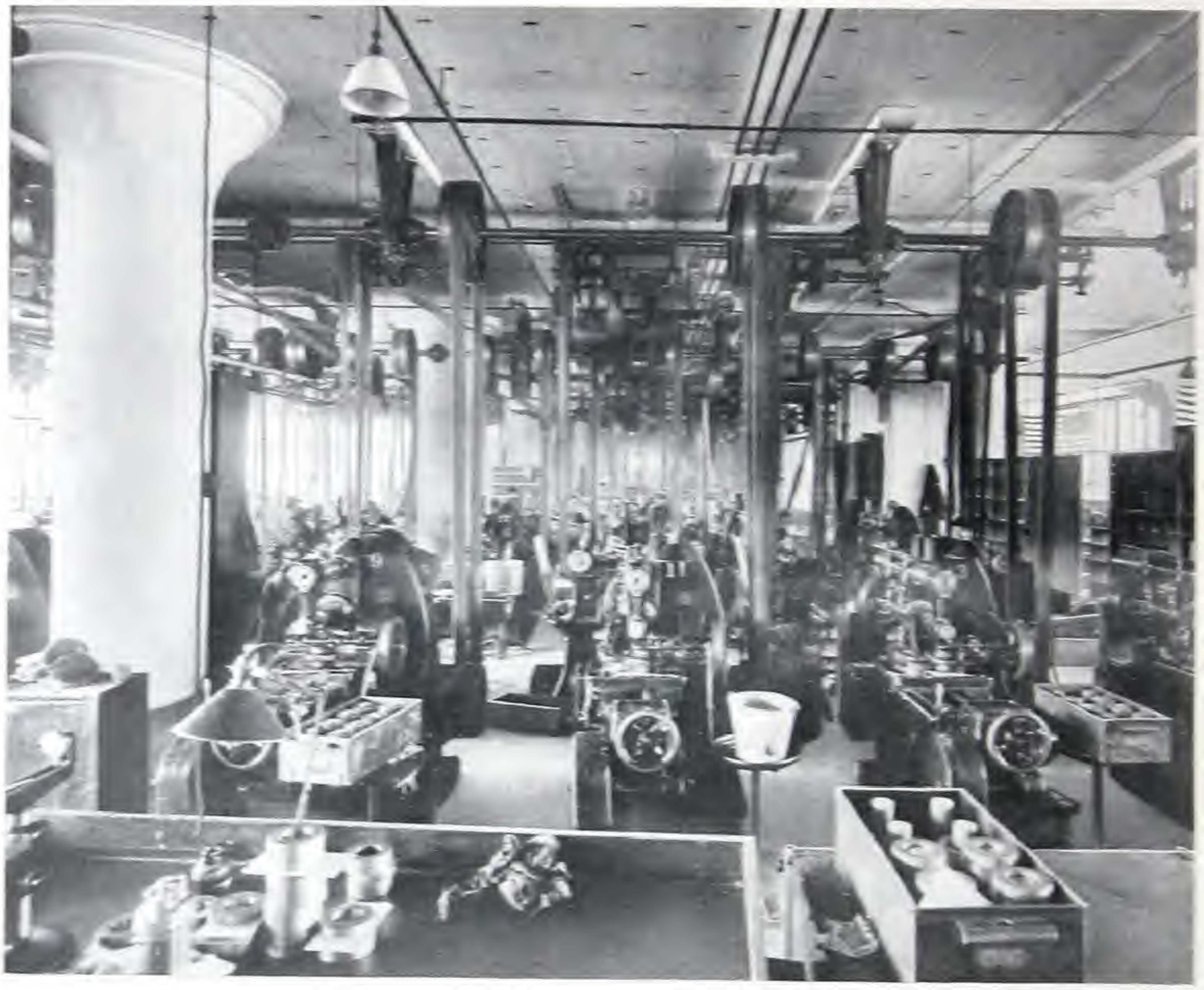
movement and should never be used in a crowded loft building dependent on natural ventilation. Neither is ordinary counter-weighted sash suitable, for the average worker will not trouble to lower the top sash. The proper type is "counterbalanced," i. e., having upper and lower sash hung over one pair of pulleys, so that one goes down as the other goes up.

If the building under consideration is to be one story high, and of considerable extent, the roof will have to light the central area, and to some extent ventilate it as well. This is really a subject in itself, as everything depends on the intended width of building, and means have been developed by which areas of any extent may

Work benches on the assembling floor in the Delco Building. The stationary glass panels under the counterbalanced sash help to minimize shadows on the floors. Equal top and bottom ventilating openings are assured by the type of sash used.

be both top-lighted and top-ventilated. On pages 18 and 19 this is taken up in detail.

Meanwhile let us look at a multiple-story building which



Looking down one of the central bays on the third floor of the Delco Building. Despite belts and machinery the light from the side windows carries well towards the center.

happily illustrates possible means of getting around seeming restrictions on width and ceiling height.

The Delco Building

The latest building of the Dayton Engineering Laboratories Co., makers of the Delco starting, lighting and ignition systems, was to be located on a lot allowing a building width of 88 feet. Seven stories were desired. To keep down the total height, it was desirable

to use 12-foot instead of 14-foot ceilings. Yet how were the central bays to be lighted?

The answer was found in stationary glass panels, placed under the lower sash and extending to within 15 inches of the floor. These added about 20 inches to the height of the glass area, and, by bringing the light admitted close to the floor, minimized the tendency to produce shadows under the work. Benches, where needed, are placed at right angles to the walls in order not to obstruct light, and are mostly on the upper floors, where assembling is done.

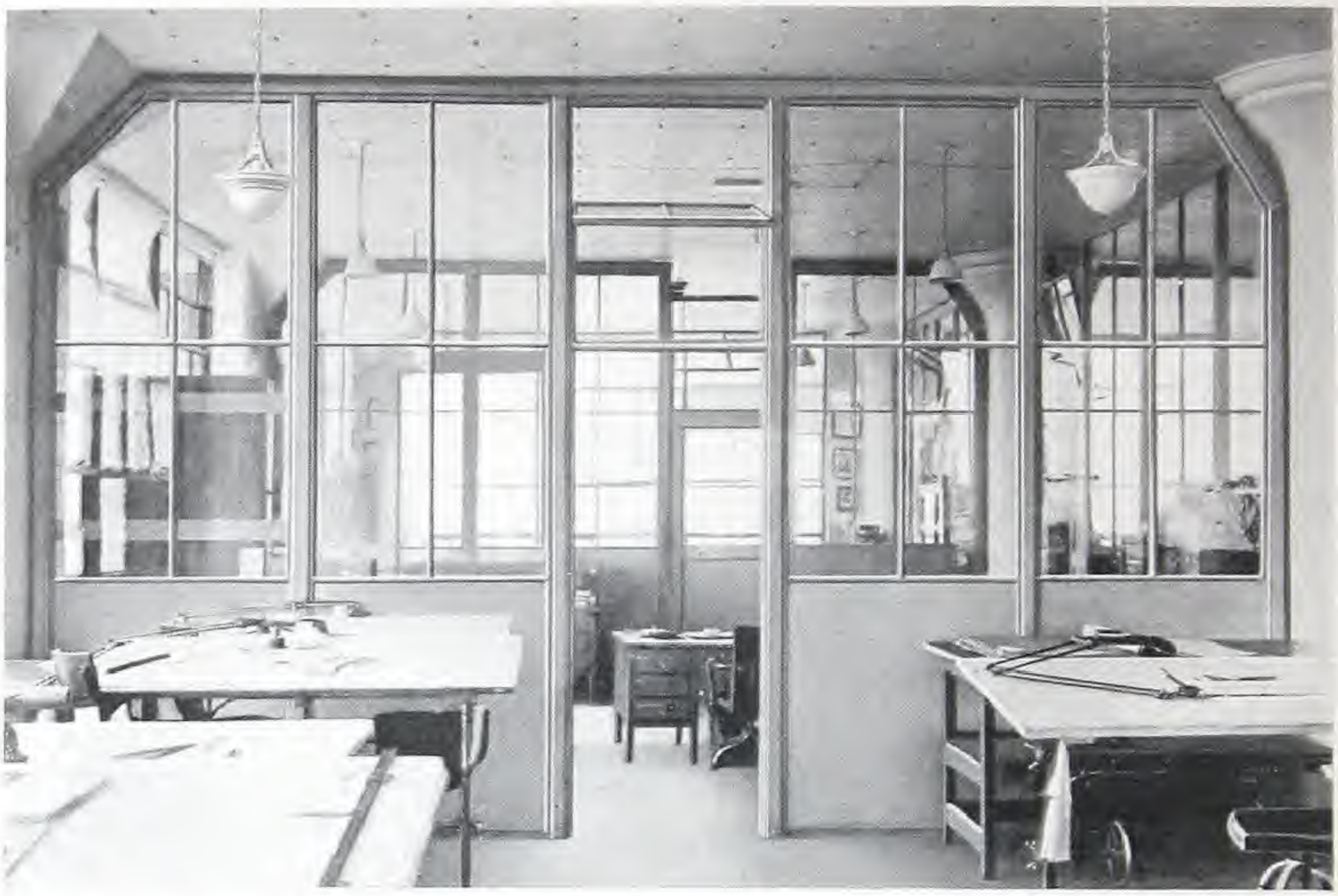
By suitably arranging the pilasters, the deep window openings are made to produce a strong and attractive panel effect which is quite unusual.

Light is further conserved by using steel and glass partitions for all offices of superintendent, time clerks, draftsmen, etc. The steel partition framing, though rigid, is very light in appearance and offers the maximum opportunity for light to pass.

Ventilation is adequately provided for by the use of counterbalanced sash (see pages 35 to 37), giving equal top and bottom openings and eliminating reliance on the workers to open the top sash.

Another advantage of using this type of sash is that it permits the use of shades if desired, which is impracticable with pivoted ventilators. These shades are so hung (page 36) as not to interfere with top ventilation.

But window design, however good, is far from exhausting the possibilities of loft-building improvement. With unlimited light and air just outside, why shut them out by tar and gravel overhead? Nearly every industry involves certain processes demanding exceptional care or skill. There may not be enough of these to justify one-story construction for the entire plant; but the top story of any factory can be treated as if it were a one-story building,—covered with a sawtooth or other appropriate roof,—and all the most exacting work concentrated there. The possibility of thus increasing the productivity of the entire plant warrants careful



Lupton Steel Partitions in Delco Building. Upper view: Drafting Room lighted on three sides by partitions. Lower view: Stock Room with Lupton steel and wire partition; also the partitions of foreman's and time keeper's offices.

Lupton Steel Partitions are interchangeable—

study of the manufacturing processes. A remarkable example of this intensive treatment, whereby scientific handling of ventilation has speeded up production, is a recently-completed building forming part of the immense Goodrich rubber works at Akron, Ohio.

Goodrich Building No. 40

This building is five stories high and has two wings, of a combined length of 500 feet. Like all the later Goodrich buildings, it is 100 feet wide; and the ceilings below the top floor are 12 feet high. This arrangement would not do for a machine shop; but the washers, calenders, molds and vulcanizers covering the primary processes of a rubber factory demand much floor space and no great visual accuracy. Hence by using counterbalanced sash for ventilation, and some artificial light in the central bays, a satisfactory result is secured.

But the top floor is a transformation indeed! Imagine these two splendidly lighted wings, each twice the size of a suburban lot, alive with the activity of a thousand men and women, all swiftly and skilfully assembling rubber boots and overshoes and arctics. Rows and rows of benches, racks and lasts fill the floor. Endless files of hand trucks come in, laden with sticky soles, heels, welts, uppers, and linings,—and return piled with moist footwear ready for the vulcanizers. The tattoo of mallets fills the air. Men handle the heavier articles —boots and men's arctics; women and girls put together the children's and women's sizes. Each worker has a definite operation to perform, after which the article is passed to the next worker, till it is finished at the end of the line.

Around one wing is a luncheon gallery, with three grills and tables for the entire force of this building. Thus the top floor of this wing is really two stories high.

As you stand at one end of the gallery and survey the bustle, what impresses you most is the method in it. There is nothing "feverish" about the speed,—rather a practised concentration on a task well-learned. It is all piece work, and the earnings are good.

Building No. 40, B. F. Goodrich Co., Akron, O. Osborn Engineering Co., Engineers. Combined length of wings, 500 ft. Width of each wing, 100 ft. The top floors of both wings are devoted entirely to assembling rubber footwear under ideal lighting and ventilating conditions. See photos, pages 13 to 16. Lupton Steel Sash, Counterbalanced Type, used in side walls.

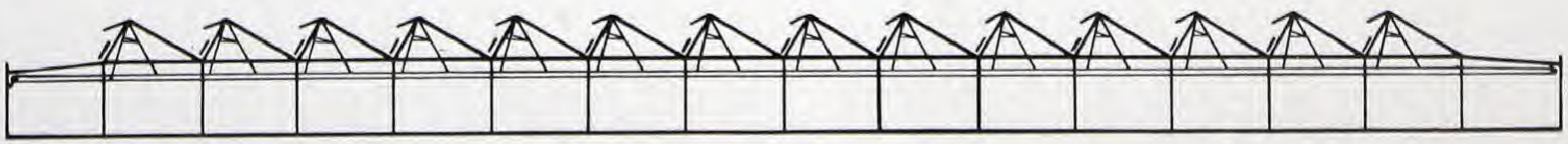


Diagram showing simultaneous control of fourteen 70-foot lines of sash in roof of right wing by Pond Operating Device. One electric motor at the direction of the foreman opens or closes all the top lines.

One motor opens ALL those top lines.

Upper view: Interior of top floor, right wing of Goodrich Building No. 40, showing restaurant gallery and 70-foot lines of sawtooth sash. All the top sash are opened or closed by one electric motor.

Lower view: Interior of top floor, left wing of same building, lighted by three 140-foot sawtooth lines whose top sash are controlled by one electric motor.

And—aside from the careful economy of motion—the big things that make the work easy are the abundant light and unfailing fresh air—the one due to the sawtooth roof above, the other to the scientific manner in which both sawtooth and side wall sash are made to work together to produce natural air renewal in all weathers.

The basis of this mode of ventilation is the use of a type of sash (page 38) which can stay open in all weathers without admitting rain or snow. It is known as "continuous;" it is hung from the top, under an overhanging angle, hence rain cannot blow over it. Its 20-foot sections are joined by weather proof expansion caps, so that it forms an unbroken line. Its ends overlap stationary storm panels which exclude rain in a diagonal wind.

Besides the upper sawtooth lines, where it acts as an outlet for stale air, this sash is used over the windows as well, forming a continuous fresh-air inlet of ample area which is independent of the whims of the workers. Each side of each wing has a line of this sash, which opens or closes as a single unit, admitting fresh air uniformly to all parts of the floor.

But there is more to the plan than this. The sash control of the ordinary sawtooth roof—each line separately governed by a hand chain, and opened or neglected at the caprice of the workers nearest the chain— would not do at all for this Goodrich building. Fresh air *must* be admitted here,—stale air *must* be afforded an immediate exit, not here and there, but the entire length and width of roof.

The answer was to connect all the movable sawtooth lines in each wing—fourteen 70 foot lines in one wing, three 140 foot lines in the other—and operate all the lines of each group *simultaneously by a single electric motor* under the control of the foreman. Thus the mere pressure of a button opens every line of roof sash in either wing to any degree desired. Fresh air reaches every part of the floor directly: stale air simply goes straight up and out, with no time to cool and descend before finding an exit. As the shape of both

 Ventilation is just as important when it rains.

Upper small halftone: Roof of right wing of Goodrich Building No. 40. Each line of Pond Continuous Sash forms a weatherproof shelter over its opening.

Lower small halftone: Idler end of tension transmission rods by which the 14 short sawtooth lines are controlled.

Large photograph shows electric motor and winding drum in right wing. A counterweight is hung in the box column in foreground. Each sash line is controlled by a triangular lever, which acts through toggle arms on tension rods running parallel to the sash. These rods act on the sash through compound levers like those shown on page 43.

Top-hung continuous sash with stationary storm panels.

sash and roof prevents air from blowing in, there are no down drafts to upset the ventilation.

Since control of both sawtooth and inlet sash lies with the foreman, neglect of individual workers to open windows can do no harm. In summer, of course, they open the windows without prompting: and as these are counterbalanced the maximum air is available.

Roof of left wing, Goodrich Building No. 40. The three sawtooth lines are each 140 feet long, and the movable top lines of Pond Continuous Sash are controlled simultaneously by one electric motor through mechanism like that shown on page 15.

This Goodrich factory has been so fully described because its simultaneous control of all roof sash represents the best possible use of a sawtooth where north lighting is preferred. There is, however, another type of roof, already in extensive use for single story structures, and soon to be seen on multiple story buildings, which avoids certain limitations of the sawtooth and gives a combination of uniform lighting and abundant air supply available with no other commercial type of roof. It is known as the Pond Truss, and is illustrated on pages 18 and 22-23.

Limitations of the Sawtooth

While the sawtooth marked a great advance in factory construction and gives excellent service in buildings of ordinary size, it has two limitations:

First, it gives a one-direction light. In a very wide building, machines and objects under the sawtooth have a light side and a shadow side; and the workers are more comfortable when facing away from the sash.

Second, a sawtooth roof, unaided, will not ventilate a wide building. The reason is that there is no portion sufficiently raised above the sidewall sash to create a natural current reaching all parts of a wide floor. For this reason such notable sawtooth structures as the Ford Motor Co. machine shop, covering hundreds of feet in each direction, are ventilated by artificial means, the sawtooth openings serving merely as outlets for forced draft.

The Pond Truss

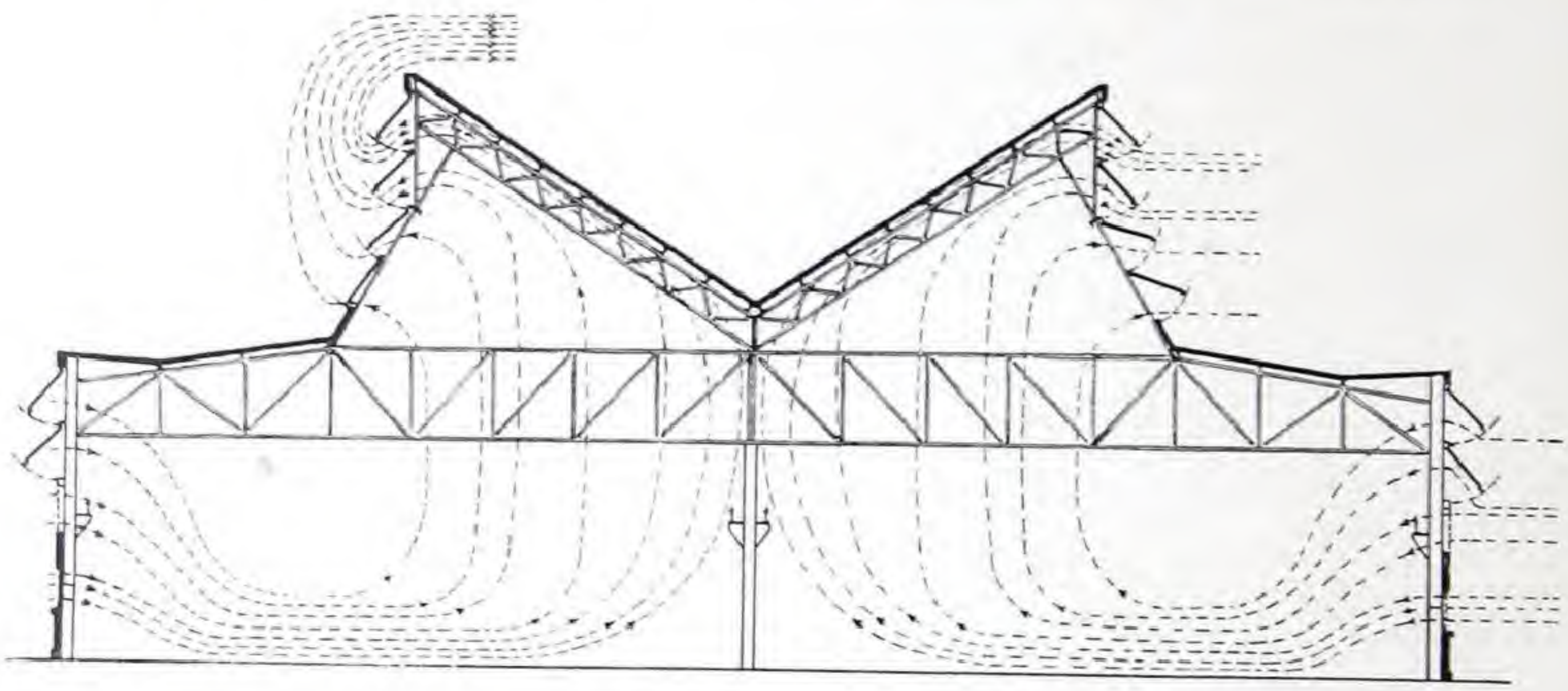
Both of these limitations are avoided in the Pond Truss. It gives an *all-directions* light which almost eliminates shadows; and it combines low intakes with moderately raised outlets in a way that causes very rapid natural change of air. Its lighting qualities make it valuable even for buildings of moderate size; for very large buildings it is the only practical roof design which does not involve forced ventilation.

The principle of the Pond Truss is shown in the sectional drawing on page 18. The central portion of the roof, for the entire length of the building, is inverted like two great wings, whose slope deflects heated air directly to the outlets. These outlets are protected by lines of Pond Continuous Sash, any or all of which may be opened. Any suitable sash—preferably counterbalanced, with a top line or lines of Pond Continuous Sash—is used in the side walls.

The drawing shows the course of the escaping air currents in a cross wind. Old-style roof monitors, with peaked roofs and centrally-

pivoted sash, allow the wind to blow straight across, thereby chilling the ascending air currents, causing down drafts, and upsetting the entire ventilating scheme. This is prevented in Pond Truss roofs partly by the shape of the roof, which forces the ascending currents strongly toward the outlets, and partly by the fact that the sash is top-hung, hence does not permit air to blow over it.

A characteristic feature of the Pond Truss is the division of outlet sash into vertical and sloping units. This facilitates the movement of escaping air by avoiding abrupt turns such as might retard it.



Section of typical foundry with Pond Truss roof, showing direction of air currents in cross wind. The lower lines of Pond Continuous Sash facing the wind are wholly or partly closed, all other lines remaining open. Double lines of Pond Continuous Sash are placed over the ordinary side wall sash to provide weatherproof inlets.

As is apparent from the photographs and from the sash arrangement, lighting is very abundant and evenly diffused; there are no dark corners anywhere. What little direct sunlight enters is scattered by ribbed glass and tempered as to heat by the rapid air movement. The under sides of the inverted roof are painted white, thereby utilizing by reflection light which is lost with the ordinary roof design. See the frontispiece and page 21.

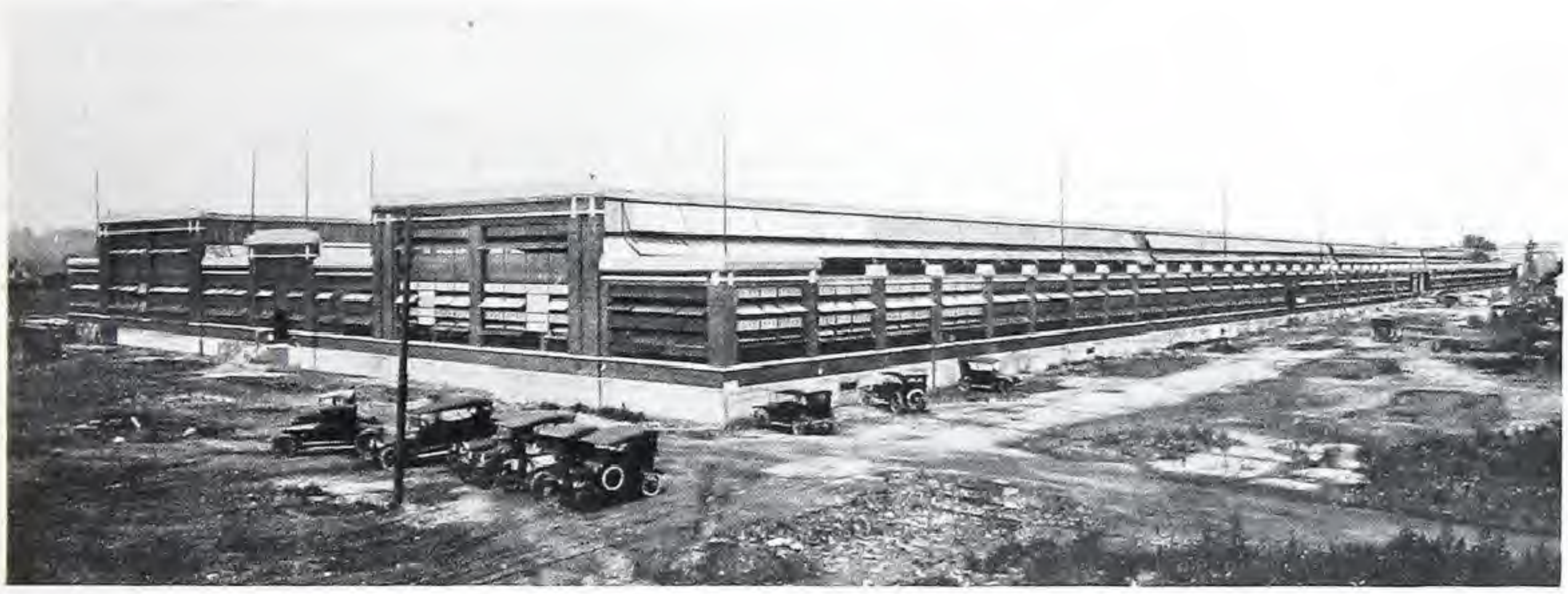
The Pond Truss was first designed for foundries and forge shops, where the value of rapid air renewal and uniform lighting is emphasized by their absence in buildings of usual design. In

 We demonstrate Pond Truss ventilation by smoke tests.

foundries, etc., escape of heat is hastened by locating the cupolas, molds, furnaces and rolls under the outlets, so that heated air and gases go straight up and out.

The height and width of the Truss, the number and size of outlets, etc., are all matters to be carefully studied in connection with the general design of the building and its use. We design every Pond Truss roof especially for its intended purpose.

For very wide buildings two or more Pond Trusses are used, with fresh-air inlets between them: these inlets being protected, like the outlets, by lines of Pond Continuous Sash.



First section of Domestic Engineering Co. Building, Moraine, near Dayton, O. Messrs. Schenck & Williams, Architects. Mr. O. Kressler, Maintenance Engineer. When completed this will be the largest single story factory yet built under one continuous roof.

The "Delco Light" Factory

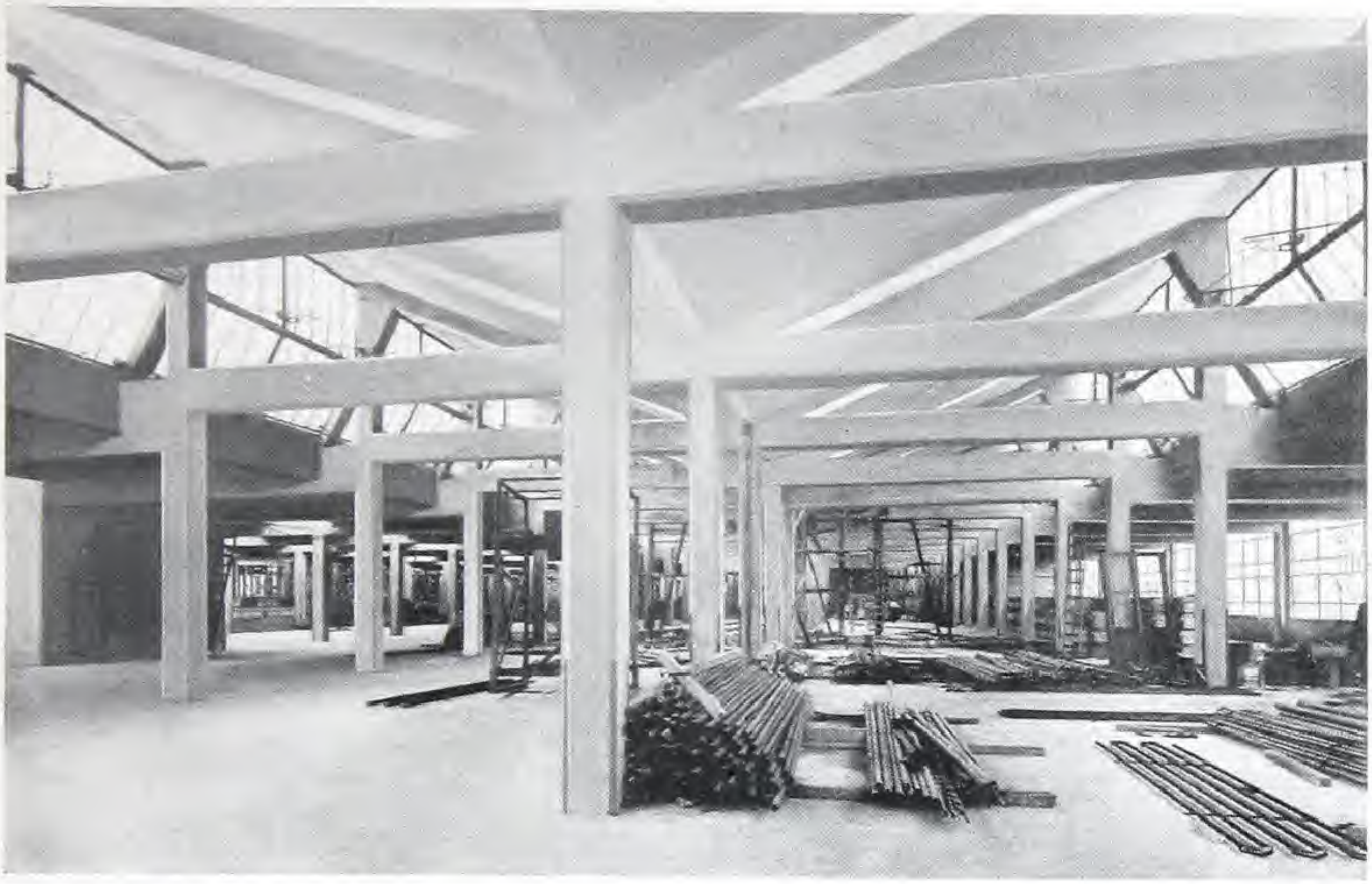
Among general manufacturing buildings the most notable example of Pond Truss construction is the recently finished building of the Domestic Engineering Company, at Moraine, Ohio. This remarkable building, of which the first section is illustrated, is now 270 by 1000 feet; but it will ultimately be 870 by 2000 feet—40 acres under one continuous roof. It will be the most striking example anywhere of the possibilities of single story factory design.

The product—the "Delco Light" gasoline engine and dynamo outfit for country houses—calls for a high degree of accuracy in both mechanical and electrical work, combined with the most

Two views of roof, Domestic Engineering Co. Building. The upper view looks between the Pond A-frames, which are closed. The lower view shows the Pond A-frames partly open, and partly-open sash lines of the Pond Truss beyond.

modern methods of intensive manufacture. While it could have been manufactured in a loft building, the advantage of having everything under one roof, with no stairs or elevators, led to the adoption of the unique plan shown.

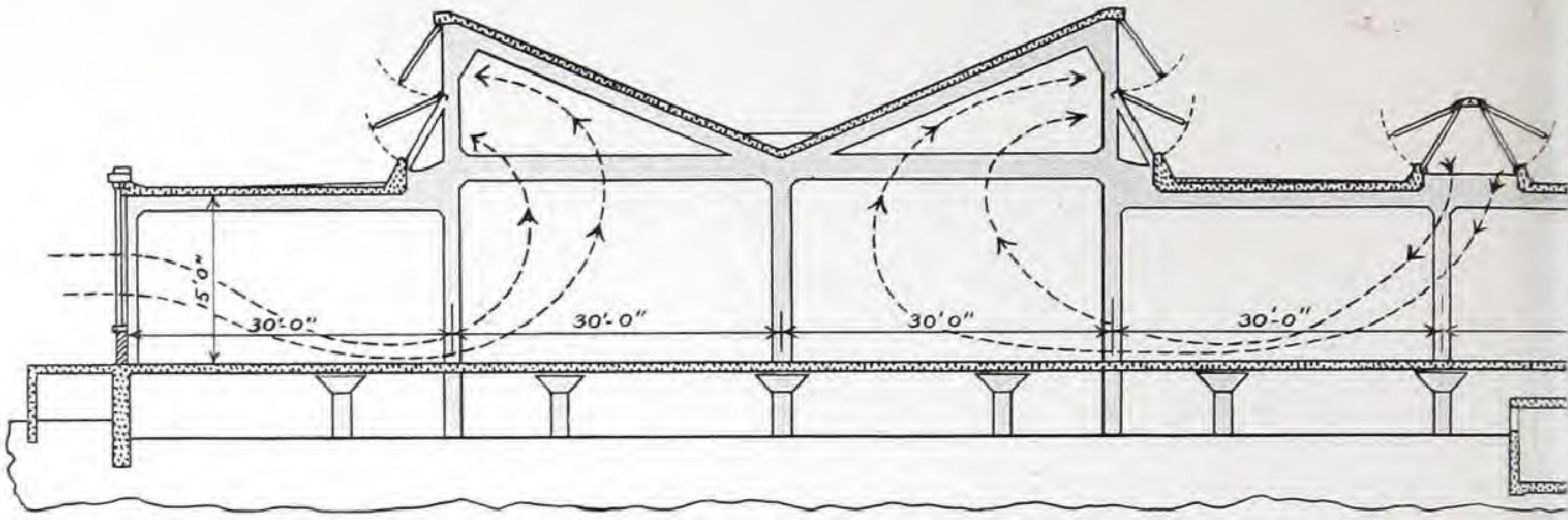
 See the diagram, pages 22-23, for ventilating action.



Looking lengthwise down the unfinished Domestic Engineering Co. Building.

Looking across the unfinished Domestic Engineering Co. Building. The uniform distribution of light from the two Pond Trusses and the two Pond A-frames is noteworthy.

It will be just as light and airy when it's 870 feet wide.



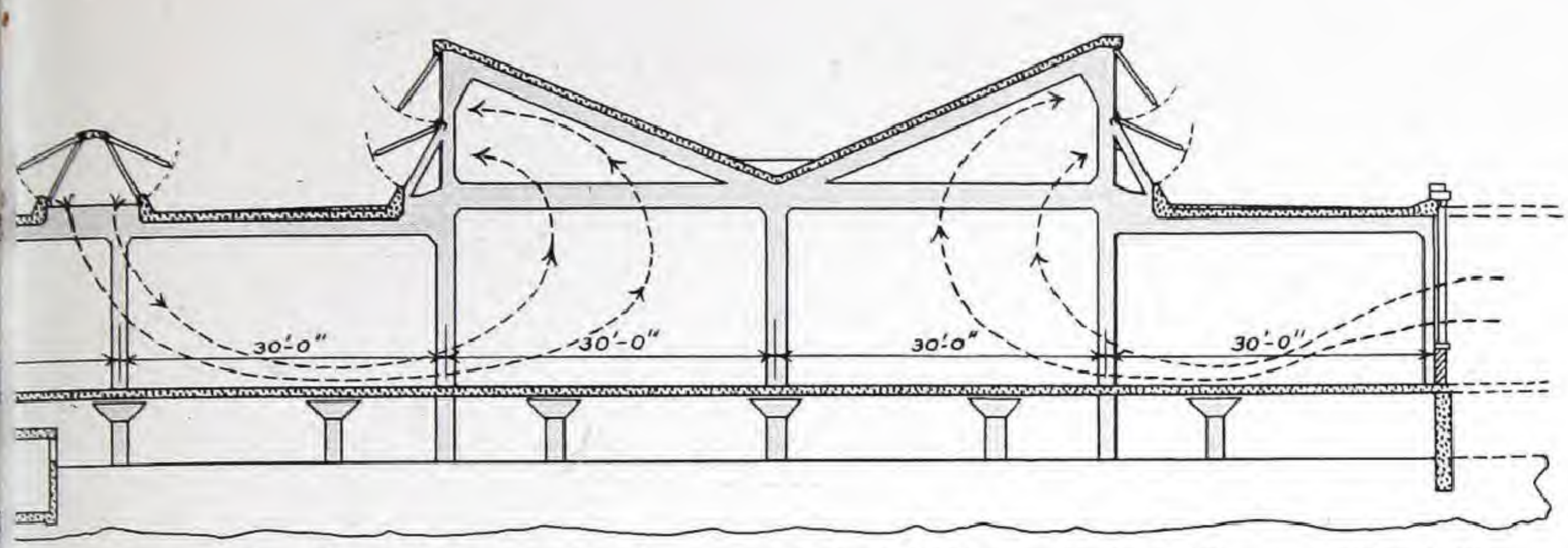
Cross section of first portion of Domestic Engineering Company's factory, showing course
admit light and discharge air. Pond Continuous Sash in lines 400 to 600 feet long is used in bo

Briefly, the roof is a series of Pond Trusses, between which are ventilating inlets, called Pond A-frames, in low points of the roof. Outlets and inlets are of equal area, and both are protected by lines of top-hung Pond Continuous Sash, which are weather proof even when wide open. To insure uniform distribution of air, both inlet and outlet sash lines are controlled, in lines of 400 and 600 feet, by electric motors under the direction of the foremen.

In this and similar buildings it is the rule to locate all processes

Interior of Domestic Engineering Company's factory, showing Pond Operating Device, Motor Driven, controlling lines of Pond Continuous Sash in the roof. Lupton Steel Sash, Pivoted Factory Type, is used in side walls.

Fresh air is as needful as good tools—



r currents. Two Pond A-frames in the center admit light and air. The two Pond Trusses
frames and Pond Trusses. Each sash line is controlled by an independent electric motor.

requiring heat—such as welding, enameling, etc.—under the Pond Trusses, thereby ensuring that up-drafts shall flow directly to the outlets. This feature, with the width and height of the inverted roof to suit the processes under it, and the location and design of air inlets, are all carefully studied in the original design.

By combining Pond Trusses and Pond A-frames in the above manner it is possible to have a one-story building of *any width and length*. There is no need of having separate buildings in order to get light and ventilation; heating costs are reduced, handling is simplified, and every process can be located in the most advantageous relation to every other. The saving in wall construction alone offsets the greater cost of the roof: but the real advantage is in the combination of maximum efficiency with minimum operating costs.

Willys-Overland Co., Toledo, O. Building 45. Messrs. Mills, Rhines, Bellman & Nordhoff, Architects. The sawtooth roof is lighted and ventilated by lines of Pond Continuous Sash. Lupton Steel Sash, Counterbalanced Type, is used in side walls. Like many of the Overland buildings, this is built around light courts. See page 24.

The Willys-Overland Factory

Although the single-story Pond Truss building is ideally suited to the average manufacturing plant employing much skilled labor, there will always be conditions under which the multiple story building must be used. High land values, in particular, make one-story construction prohibitively costly; and inability to secure the right site may lead to the same result.

Pond A-frames in roof of light court in one of the Willys-Overland buildings. Almost the entire roof area of the light court is available for light and ventilation.

The Willys-Overland factory in Toledo is located in a built-up district which restricts its lateral growth. Yet the enormous growth of its sales had to be met. The most intensive methods of manufacture, coupled with more than ordinary skill, were necessary, and with them a floor area amounting now to more than 100 acres,

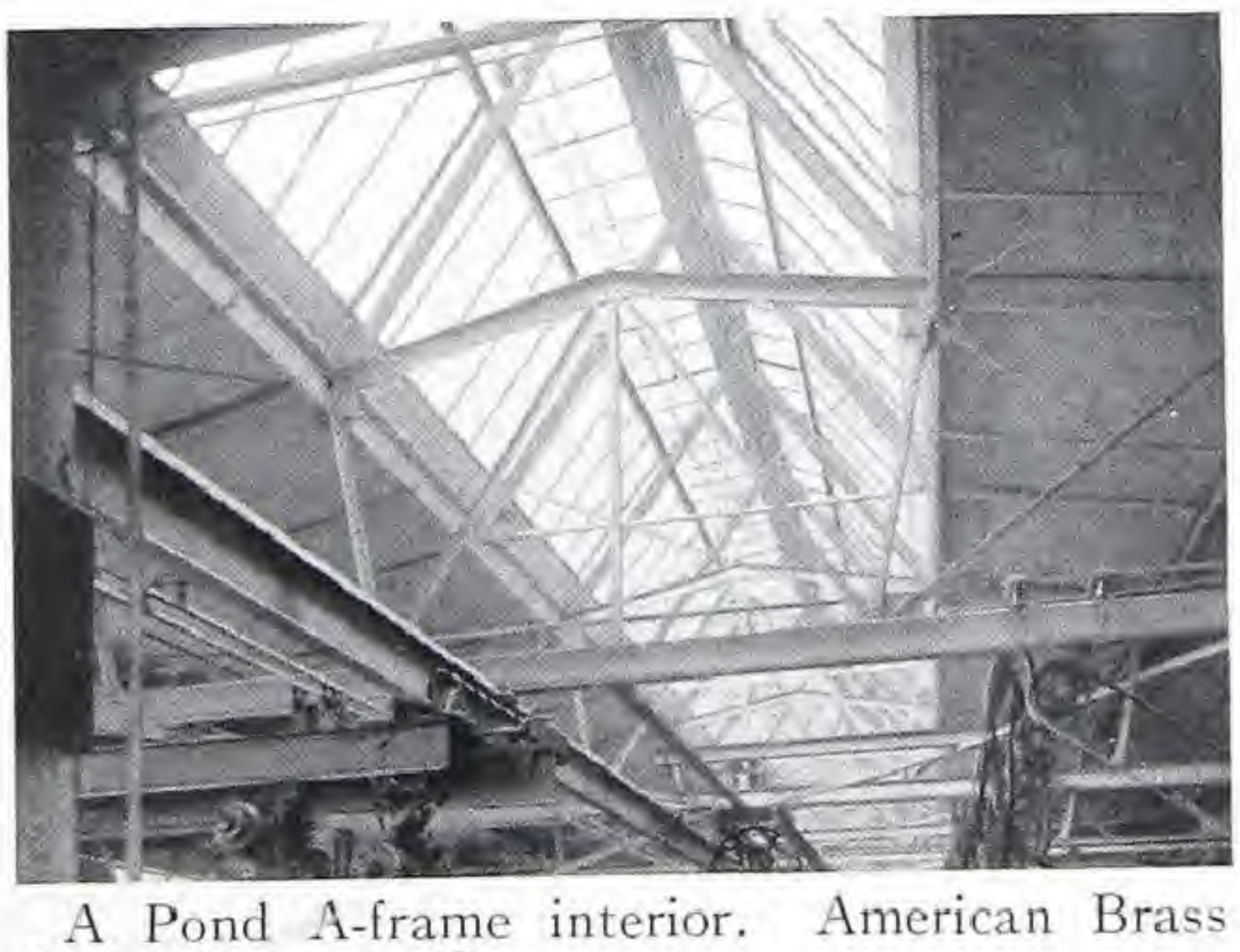
which gives a capacity exceeding 1000 Overland and Willys-Knight cars per day.

Under the conditions stated, multiple story construction was necessary; and, as a large fraction of the total work demanded both skill and speed, the problem was to utilize to the maximum the air and light available.

In working out this problem the first step was to restrict both the height and width of the buildings, in order not to cut off light from the lower floors or air and light from the centre bays.

Most of the buildings are three or four stories high, with 14-foot ceilings to give good light distribution. All the wider buildings have light courts — one as many as six; and for maximum utilization of space these courts are roofed over, one story high, with Pond A-frames, thus making nearly the entire roof area available for light and ventilation. One of these courts is shown in the illustrations.

Overhead and interior views of a Willys-Overland light court, showing the Pond A-frame roof. In the upper view the Pond Continuous Sash lines of the A-frames are closed.

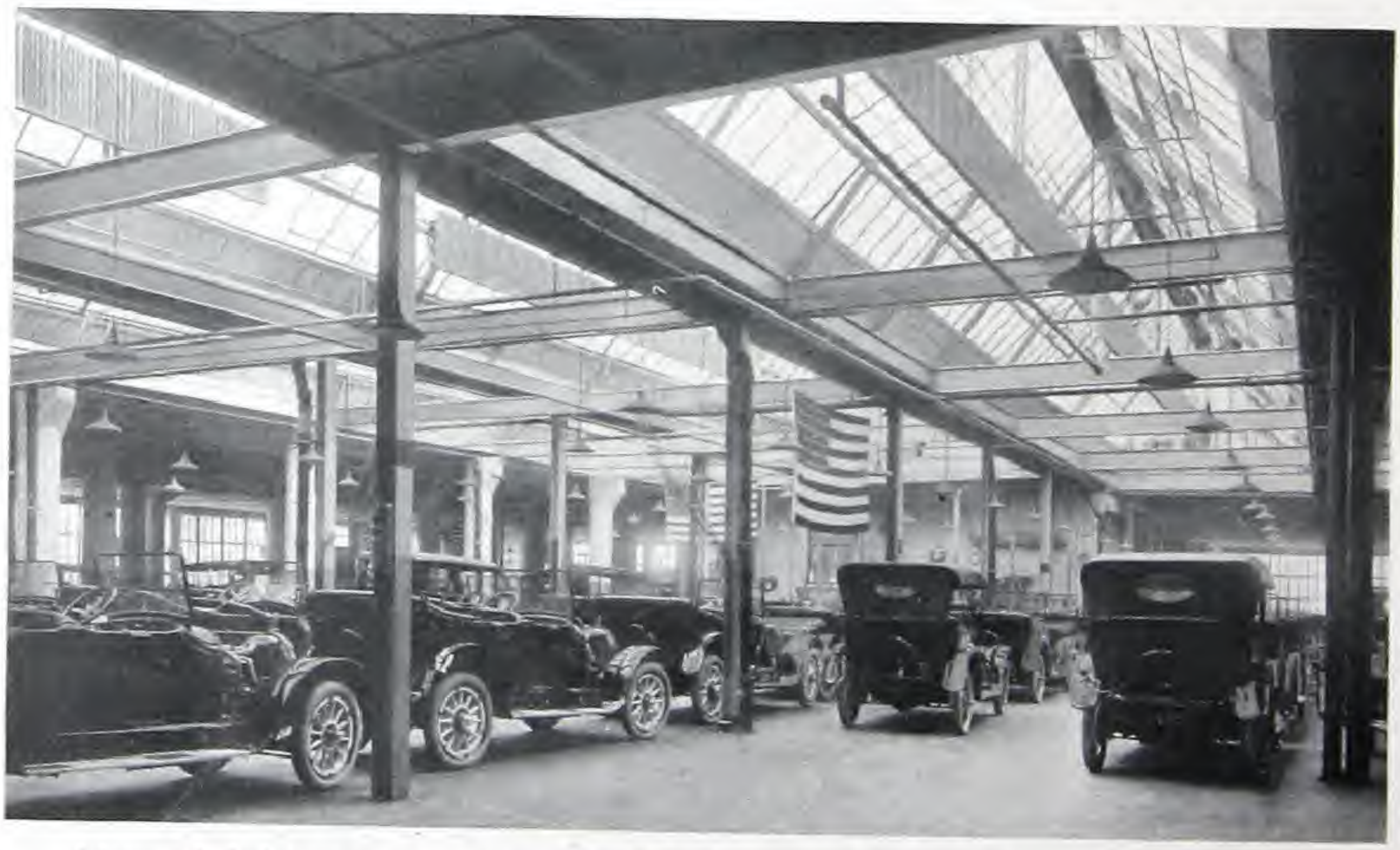


A Pond A-frame interior. American Brass Co., Bridgeport, Conn.

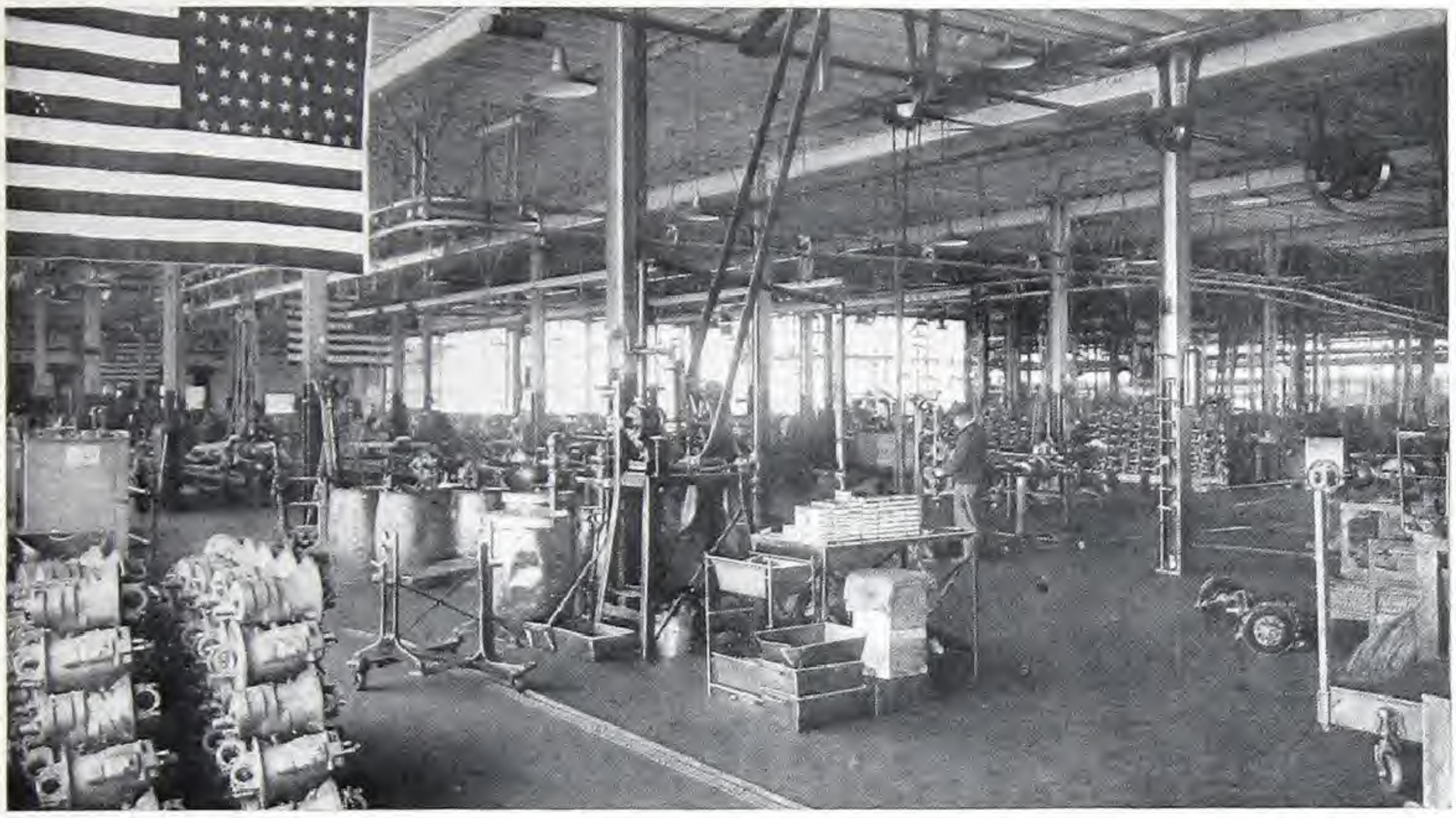
by cooperation of architects and sash makers.

Making cushions and trim in Willys-Overland factory. Pond A-frames between the two lines of columns give added light and air.

Counterbalanced sash is used in nearly all the buildings, thus ensuring equal top and bottom openings for air. By making the

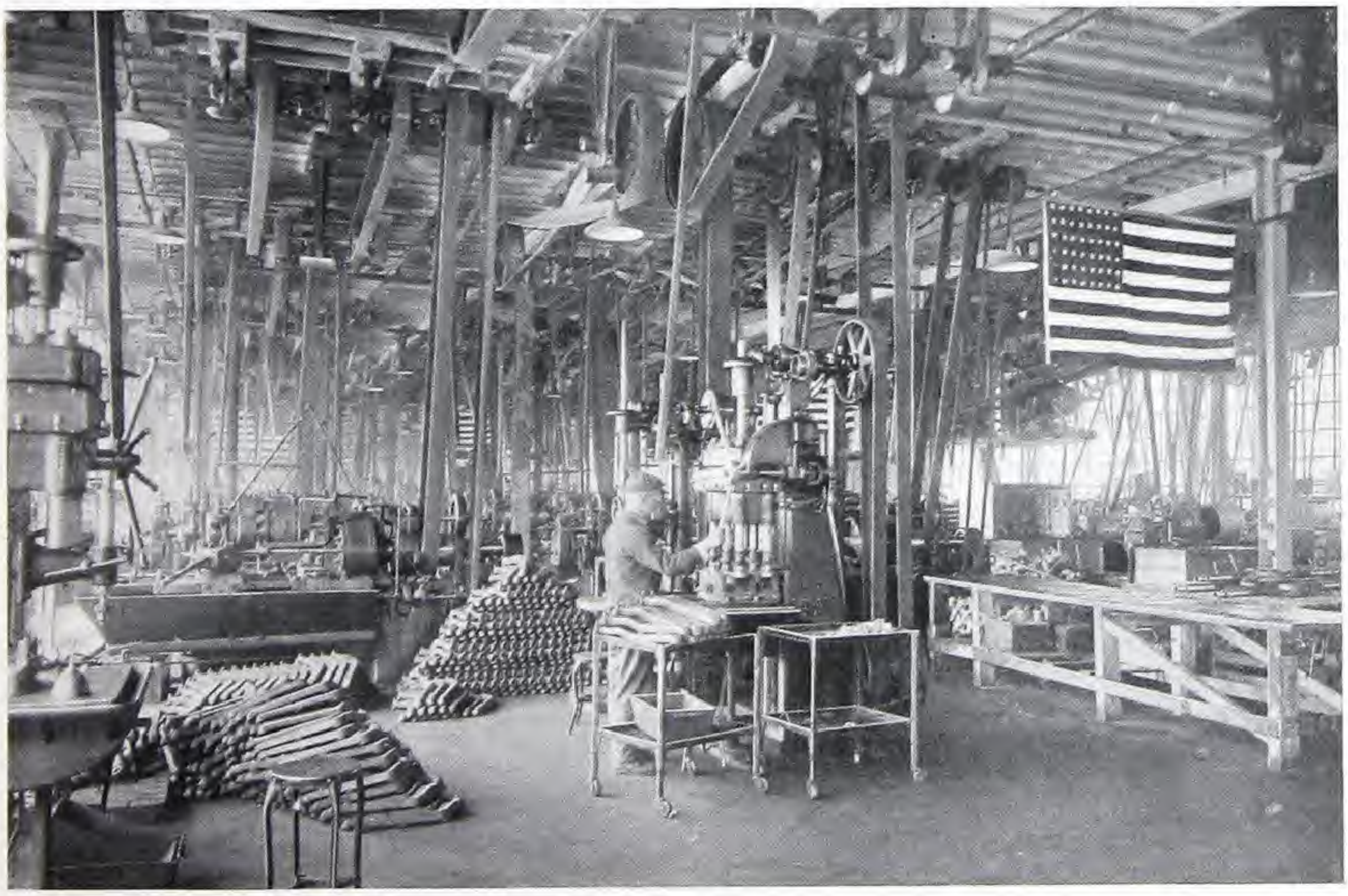


Lines of finished cars under a Pond A-frame roof in the Willys-Overland factory.



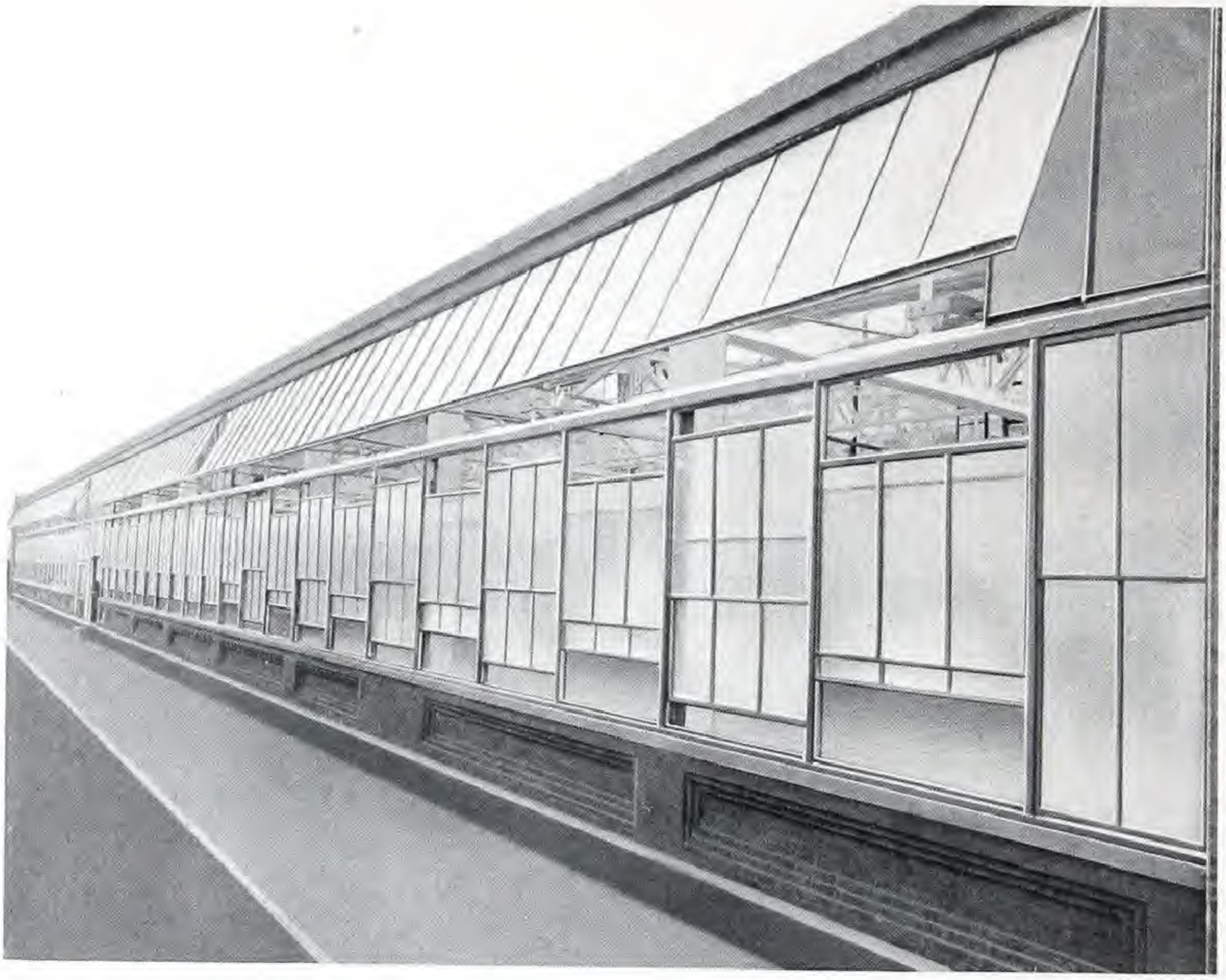
Two glimpses of the Willys-Overland machine shops. In spite of the width of the buildings the centre bays are well lighted.

sash "3-high" (i. e., upper and lower sash overlapping a stationary middle sash) the ventilating area is made nearly ⅔ of the glass area.



never got the best lighting and ventilating results.

Several of the buildings have sawtooth roofs; and two of the later buildings have Pond A-frames in the roof as well as in the light courts. On one of these top floors the cushions and trim are cut and stitched, the uniform light being of great benefit for this work. So satisfactory has the A-frame proved in these buildings that it has been applied also to a number of Overland service buildings in other cities, where it has the advantage of giving more and better-diffused light than a sawtooth.



Lead Casting Building of the Remington Arms-U. M. C. Co., Bridgeport, Conn. Mr. L. F. Hall, Works Engineer. In addition to the Lupton Counterbalanced Sash, a weatherproof inlet is afforded at all times by Pond Continuous Sash over the windows. A monitor in the roof contains four outlet lines of Pond Continuous Sash.

Continuous Sash for Ventilation

A point suggested, but not fully developed in the examples thus far shown, is the great desirability in any crowded building

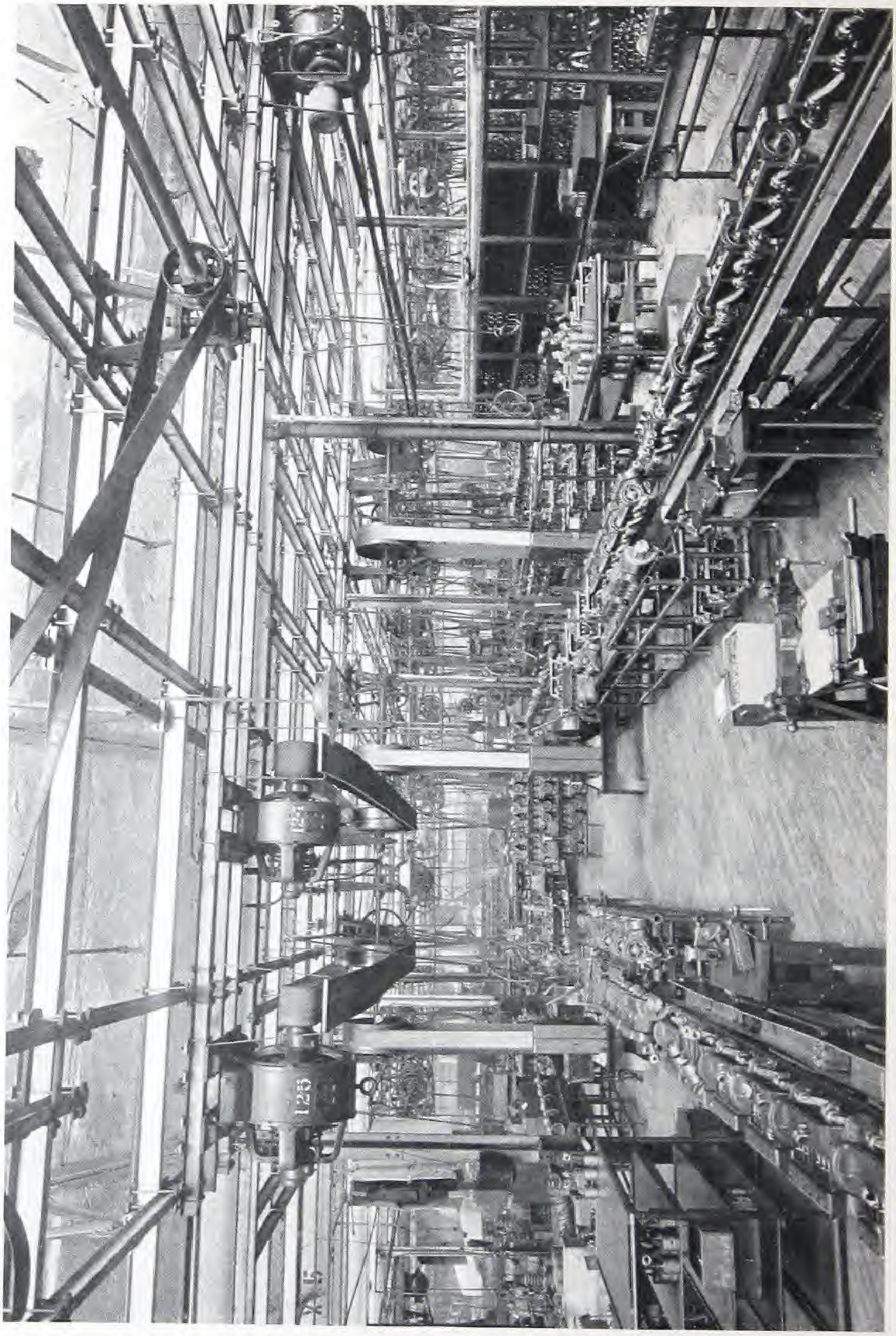
"It is well to understand human nature—

of taking the control of ventilation out of the hands of the workers, who are inclined to neglect opening the windows unless forced to do so by heat or fumes within. The best way to accomplish this is to run a line of weather proof continuous sash over the windows, with chain or motor control under the foreman's direction. A small opening in such an extended line is sufficient to provide the needed outlet or inlet in winter; and in summer both windows and continuous sash line will naturally be opened.

Such an arrangement, though in a different type of building, is shown on page 28. The building is the Lead Casting Building of the Remington Arms-Union Metallic Cartridge Co., Bridgeport; and the main object here is to disperse quickly the heat from the molten lead. As the continuous sash protects the top openings of the windows just below, the latter can remain open without danger of rain reaching the molds. A monitor is used, with four lines of Pond Continuous Sash protecting the outlets.

Pond Continuous Sash in monitor outlets of Union Malleable Iron Co. foundry, East Moline, Ill. Mr. O. A. Eckerman, Architect. Note the overhanging angle bars at top, and the storm panels at ends.

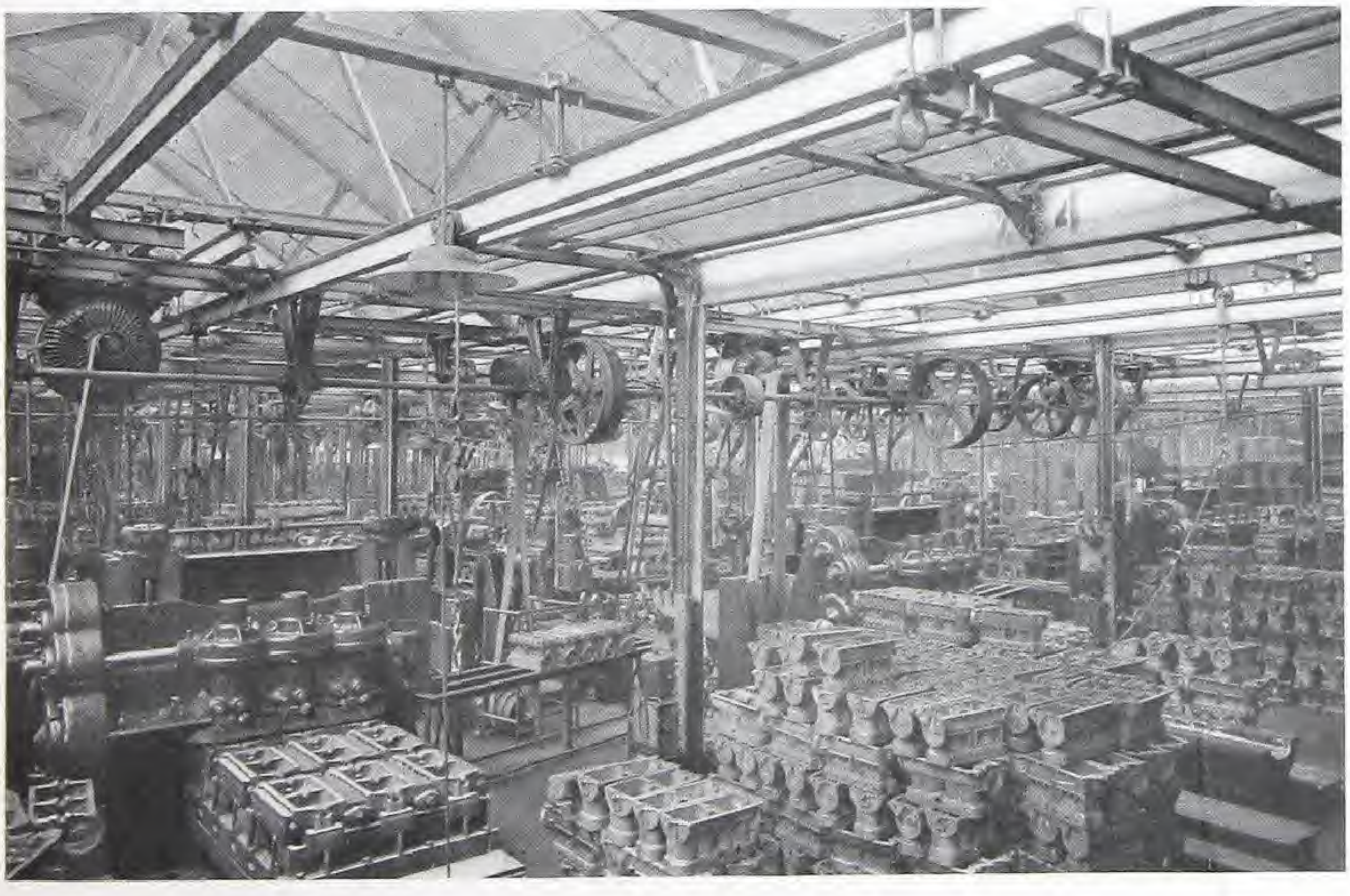
but don't try to change it."

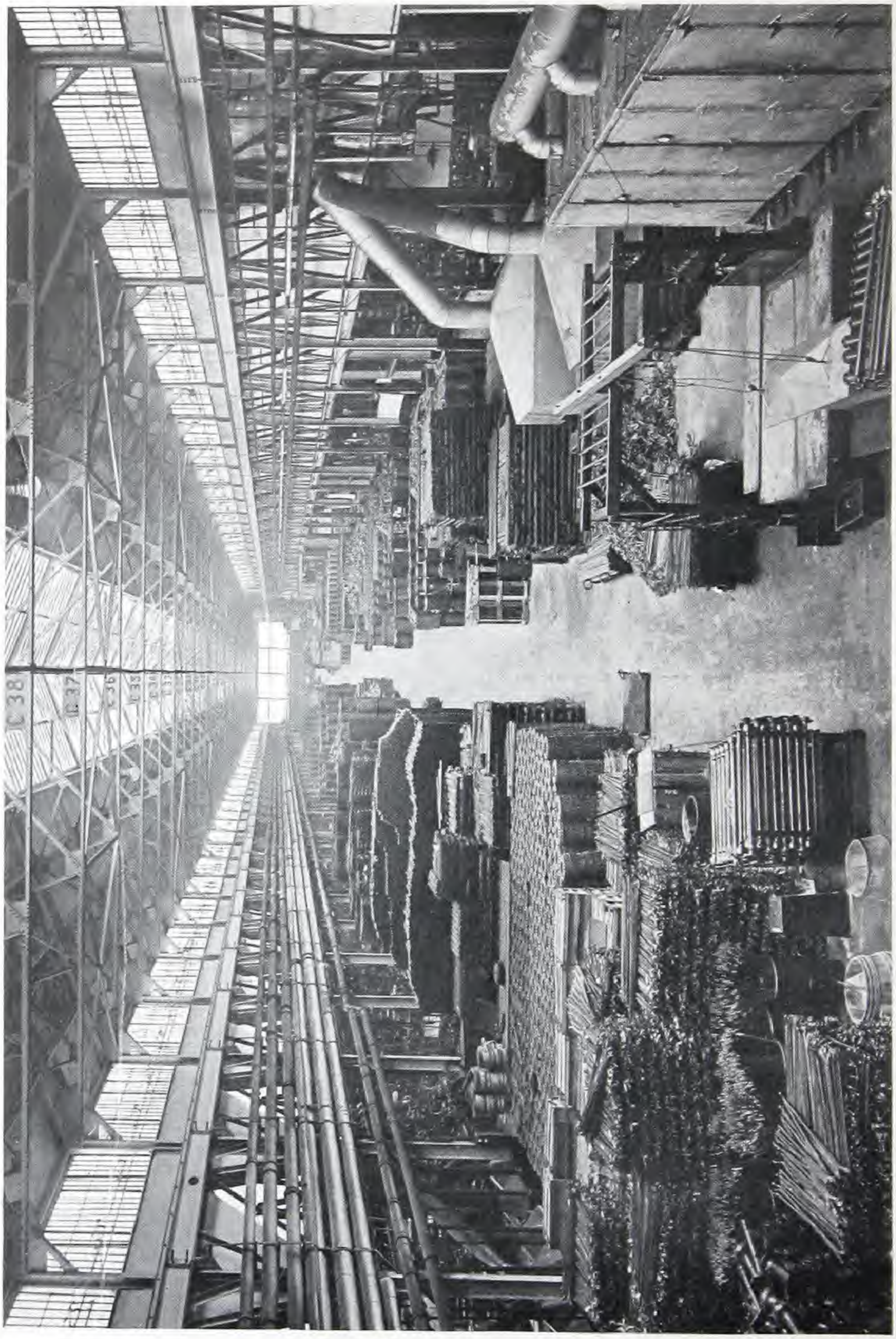


Engine Assembling Department of Machine Shop, Ford Motor Co., Detroit, Mich. Mr. Albert Kahn, Architect. Mr. W. B. Mayo, Engineer. Pond Continuous Sash with Pond Operating Device is used in the sawtooth roof. On account of the area covered, forced ventilation is necessary.

Fifteen acres of daylight—

Upper view: Engine Testing Department, Ford Motor Co., Detroit, Mich. Pond Continuous Sash with Pond Operating Device used in the sawtooth. In the foreground is seen an opening for forced ventilation at the base of a column.
Lower view: Cylinder Machining Department, same building.





Main Craneway of machine shop, Ford Motor Co., Detroit, Mich.

Have you a foundry, forge shop or power house?

Philadelphia Tapestry Mills, Philadelphia, Pa. Wm. Steele & Sons Co., Engineers and Constructors. Pond Continuous Sash with Pond Operating Device used in sawtooth roof.

Pond Continuous Sash in Sawtooths

Pond Continuous Sash, being top-hung and weatherproof, and being readily operated in long lines by the Pond Operating Device, is superior for sawtooth roofs to centre-pivoted sash, over which rain or snow can blow to the detriment of machinery or goods beneath.

The most famous installation of this sort is the machine shop of the Ford Motor Co., covering a continuous area of approximately 700,000 sq. ft.—the largest example of sawtooth construction in the world. Each "tooth" contains two lines of Pond Continuous Sash, the upper one top-hung and opened by hand chain.

In view of the vast extent of this roof and the absence of any raised feature sufficient to provide the necessary air renewal, it would have been impracticable to ventilate the shop by natural means. Forced ventilation is therefore employed, the air being washed, dried, and cooled or warmed according to the season, before it is discharged through outlets around the base of the columns. One of these outlets is seen on page 31. The sawtooth lines therefore require to be opened only for outlet, hence can stay open most of the time, and hand operation is not so objectionable as it would otherwise be.

See page 46 regarding special booklets.

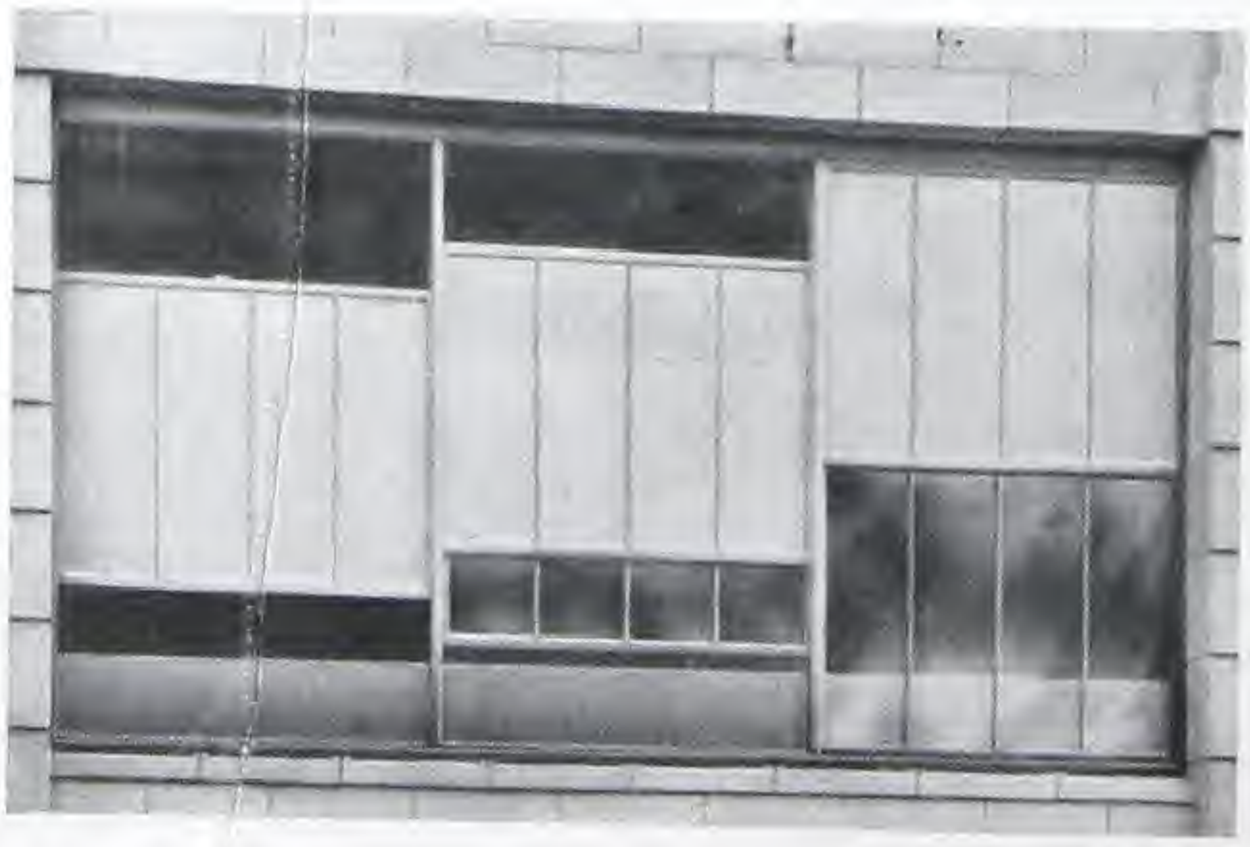
LUPTON PRODUCTS

The examples shown in the foregoing pages are only a few of those where our co-operation with the architect or engineer has produced results of exceptional value to the owner. Our purpose has been to show that every industrial building has certain possibilities, depending on the nature of the work, the number of workers, the size and shape of the available ground, the nearness and height of adjacent buildings and other features affecting the light and air available.

To utilize these possibilities is a matter for careful study, and the best results are obtained by disregarding the old notion of a factory as merely "four walls and a roof," and starting with the idea of doing everything possible both to *assist air movement* and to *admit and diffuse light.*

We do not erect buildings. As designers and manufacturers of sash, our function is to place our experience at the service of users of Lupton Products and their architects or engineers. For this no charge is made. Our Engineering Department is always ready to submit sketches based on prospective customers' requirements.

The Pond Truss design of roof is patented. We license its use in consideration of the employment of Lupton Products exclusively in buildings so designed. Our Engineering Department should always be consulted regarding the proportions of height to width, size and control of ventilating openings, etc., to secure the desired result.

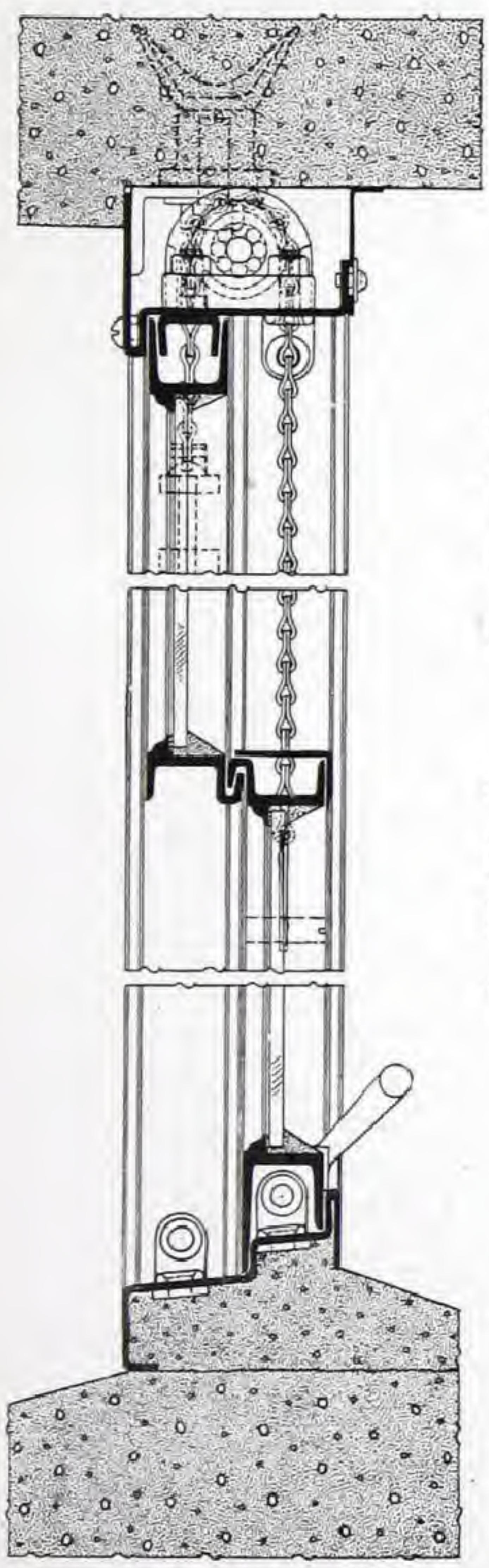


Lupton Steel Sash, Counterbalanced Type, equipped with wind shield. The upper and lower sash of each pair are hung over one pair of pulleys, so that top and bottom ventilating openings are always equal.

Every Lupton Product was designed to meet a need.

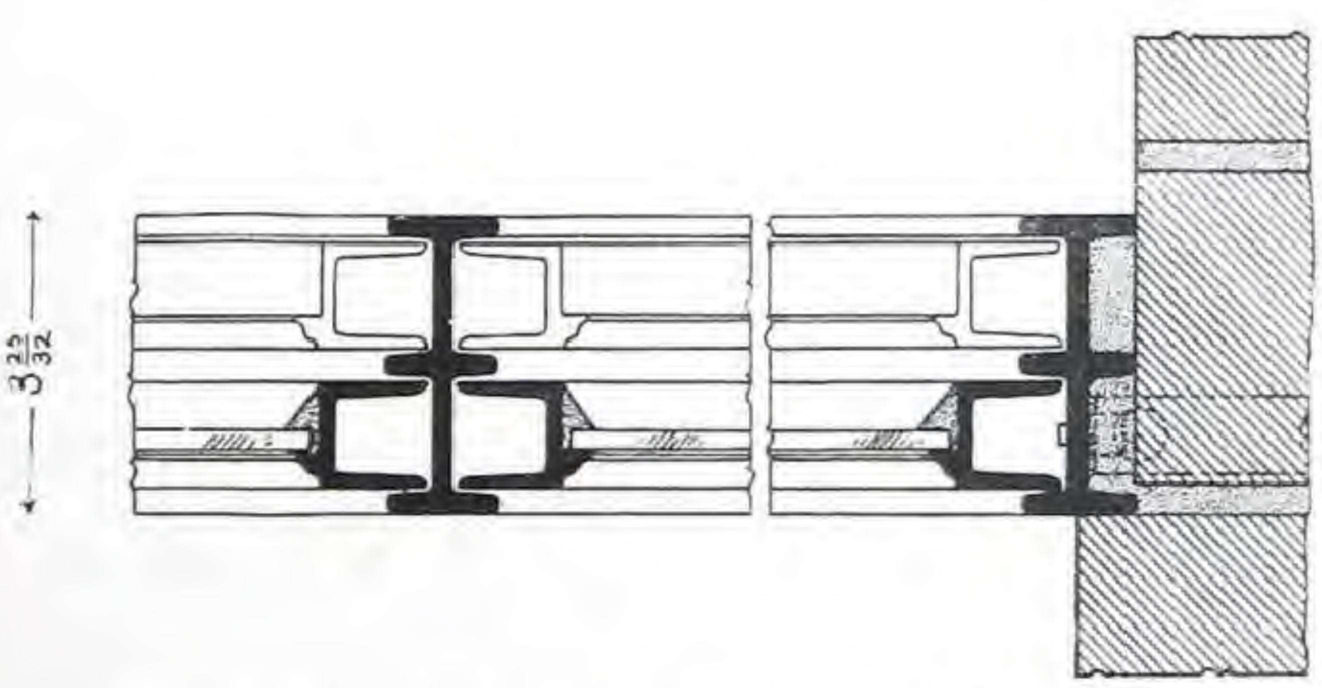
Lupton Steel Sash, Counterbalanced Type

This sash is made from heavy steel sections, of such shape as to ensure weather tightness at head, jambs, meeting rails and sill without the addition of weather strips. Being rolled in one piece, these sections are more accurate in shape than assembled sections, and are free from the danger of internal corrosion. The latter feature applies also to the sash joints, which are oxy-acetylene welded over the entire area of contact into permanently rigid units. Attention is called to the form of head and sill, the latter of which has a double rise and is keyed with the cement to prevent warping and leakage.



The top and bottom sash are hung over a single pair of roller bearing pulleys, so that they open simultaneously, thereby ensuring equal air movements without thought on the part of employes.

To ensure free ventilation, the shade holder shown in the illustrations on the next page is recommended. As the shade is hung at least 1 foot from the sash, flapping in the wind is prevented, and air has free passage



Vertical and Horizontal Sections of 2-high Lupton Steel Sash, Counterbalanced Type. The weathertight formation at head, meeting rails and sill without the use of weather stripping is noteworthy.

This type of sash is furnished with rolled bronze weathering attached to the mullions where specially ordered and at an extra price.

over it. The relation between the outside masonry projection and the height of the shade roller is such as to prevent direct sun rays from entering over the roller at a sharper angle than 30 degrees. Shades are controlled by the usual sill pulleys with automatic lock on the cord.

Shade Holder Bracket used with Lupton Steel Sash, Counterbalanced Type, to insure free escape of air when shade is drawn.

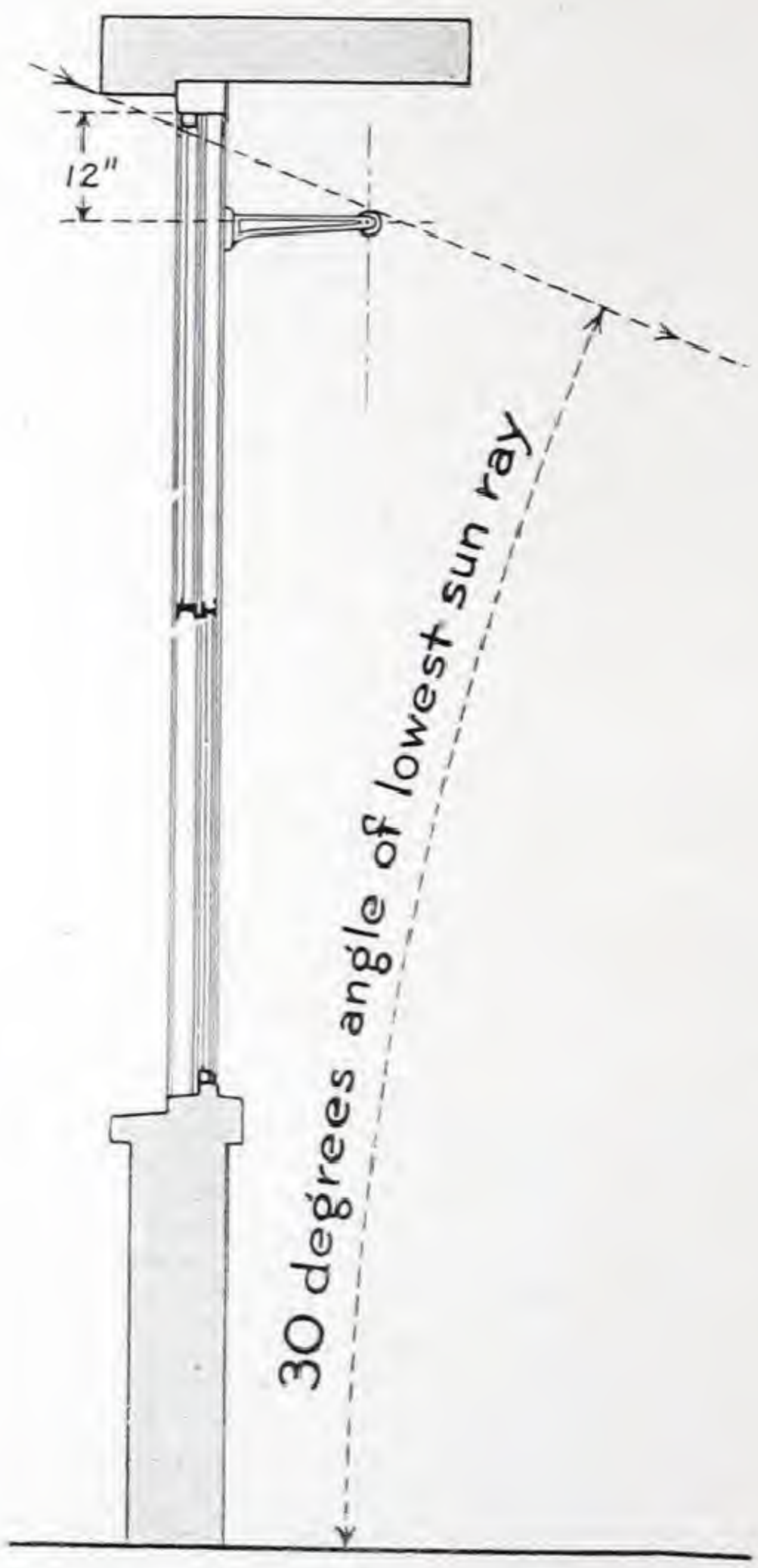
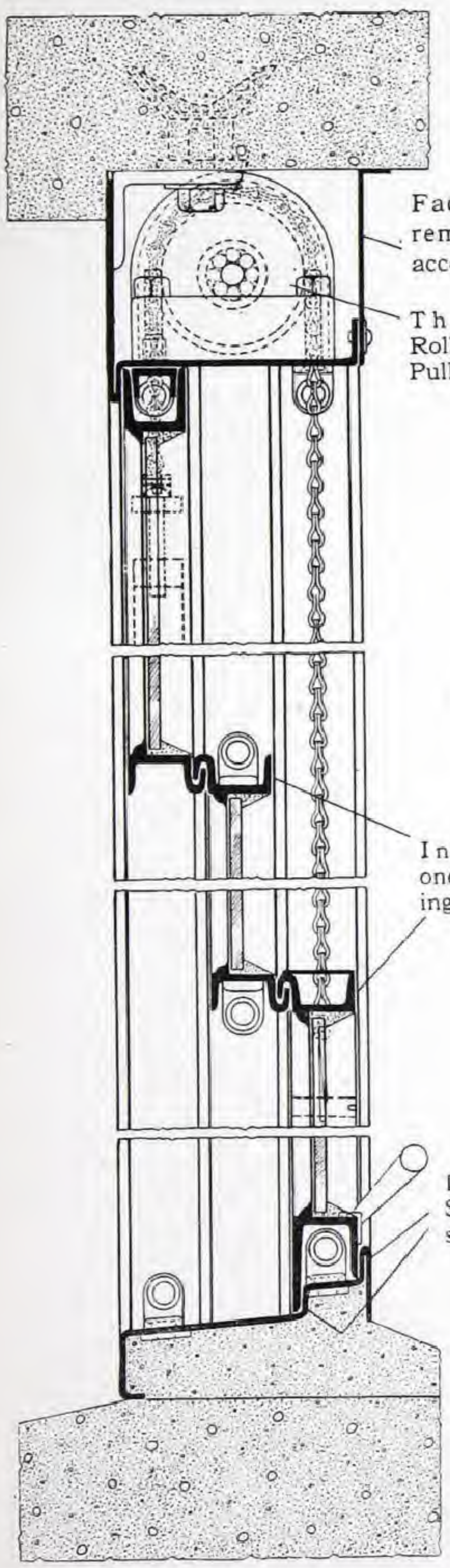


Diagram showing the placing of shade holder bracket to intercept sun rays.

Lupton Steel Sash, Counterbalanced Type, is made to fit openings of any desired size, standard glass sizes being disregarded. Units are made up to 7 feet wide and 16 feet high, and may be used

 Ever see a shade act as a check valve? This can't.

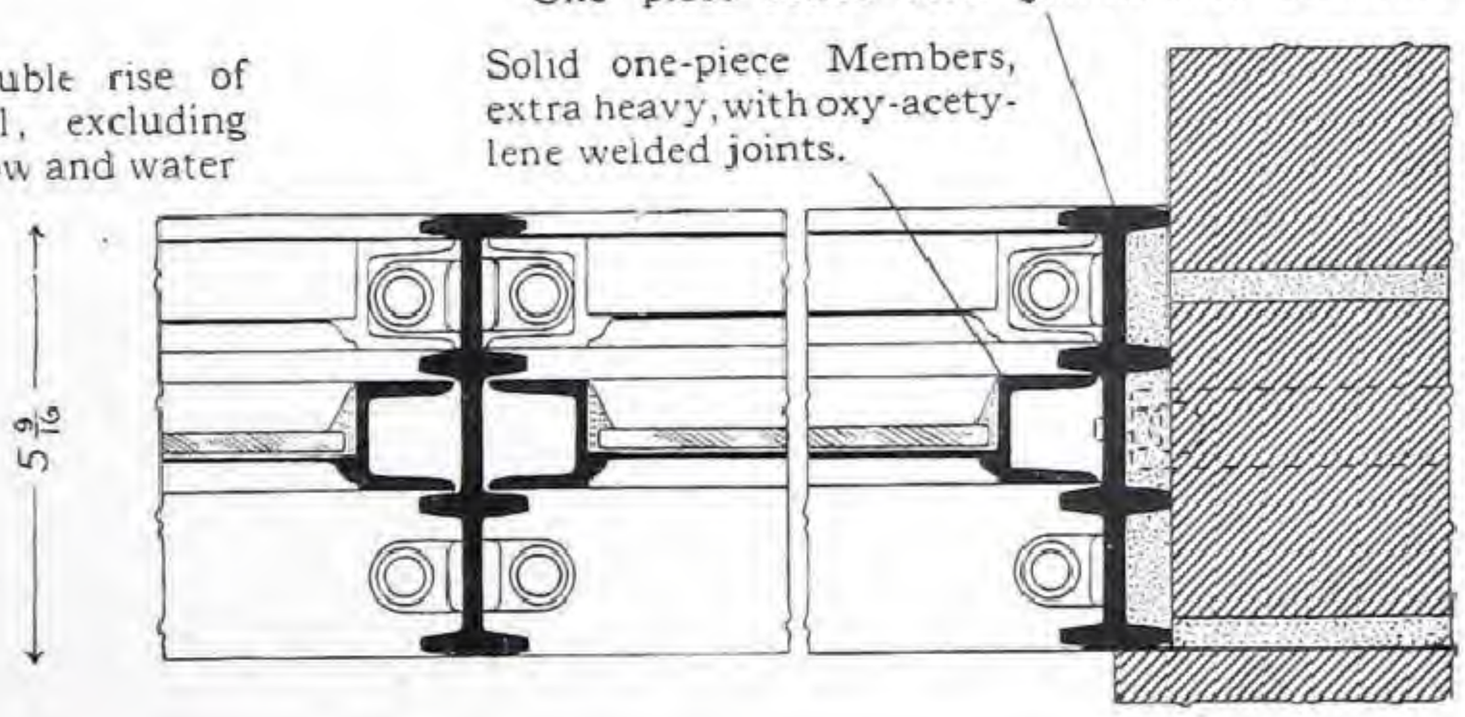
singly or in multiple. Wide units are recommended on account of better appearance and lessened air leakage. Mullions, where used, are only 1 7/16 in. wide, hence offer negligible obstruction to light.



Up to and including 12 feet in height windows are two sash high. From 12 to 18 feet three sash are used, the middle one being stationary.

No horizontal muntins are used unless specified. Appearance is improved and glass cleaning simplified by omitting them. Wind shields will be furnished when specified.

When desired, we furnish these sash to conform to the specifications of the Board of Underwriters and bearing the underwriters' label. An extra charge is made for this.



Vertical and Horizontal Sections of 3-high Lupton Steel Sash, Counterbalanced Type.

Pond Continuous Sash

We originated Pond Continuous Sash, the first top-hung continuous sash, to accomplish three results:

1—To be weatherproof when open, thus giving ventilation regardless of weather.

2—To afford the greatest effective ventilating area in proportion to sash area.

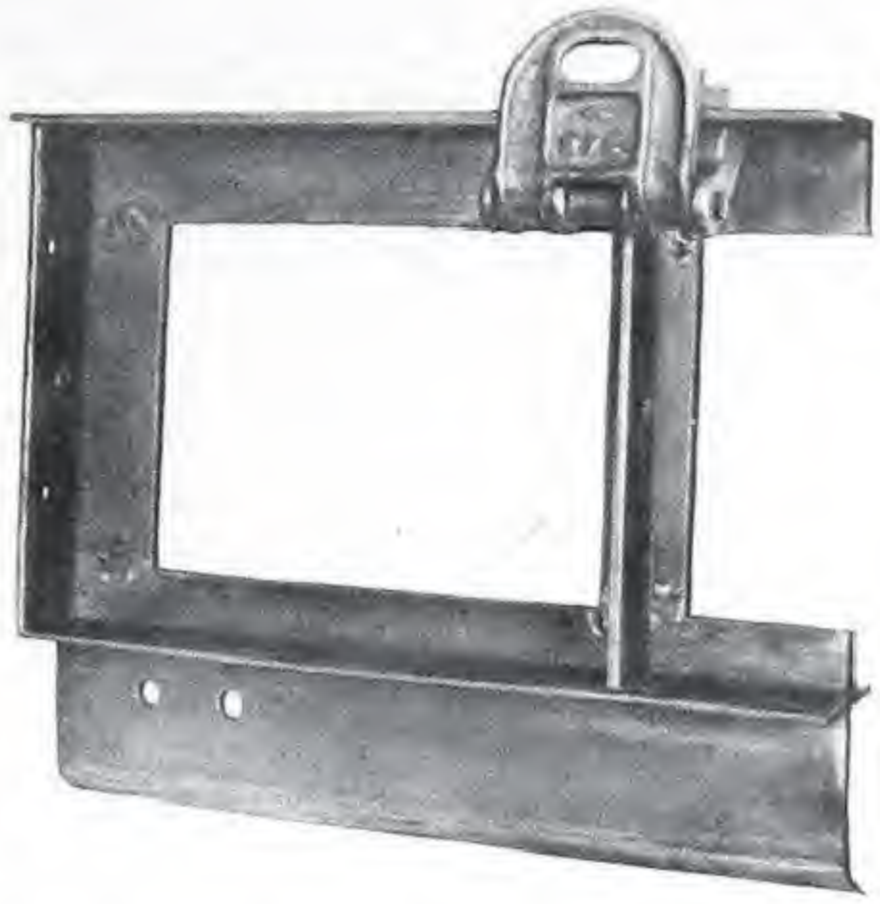
3—To facilitate the control of air inlets and outlets of large area, as is often required in foundries and elsewhere.

The weather proof feature is obtained by hanging the sash from the top, in continuous lines outside of all structural work, where it forms a transparent shed over a variable opening. A steel angle overhangs the top edge, and stationary storm panels underlap the ends, thus excluding rain in a slanting wind. See photograph, p. 28.

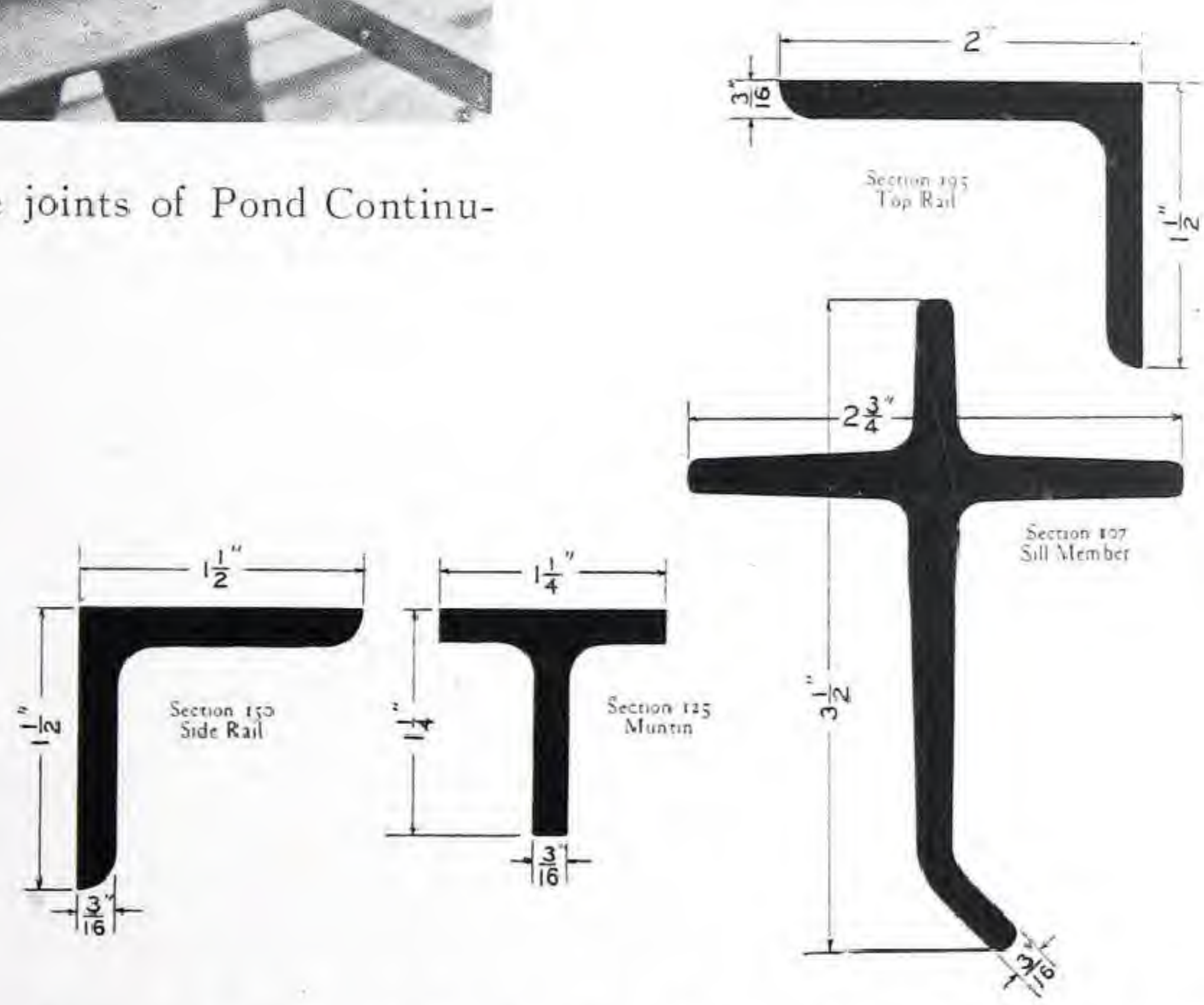
Pond Continuous Sash with Pond Operating Device in sawtooth roof of Hendee Mfg. Co., Springfield, Mass. Mr. W. C. Fronk, Architect.

 Top, outer ends, and section ends—all rain proof.

Welding the joints of Pond Continuous Sash.

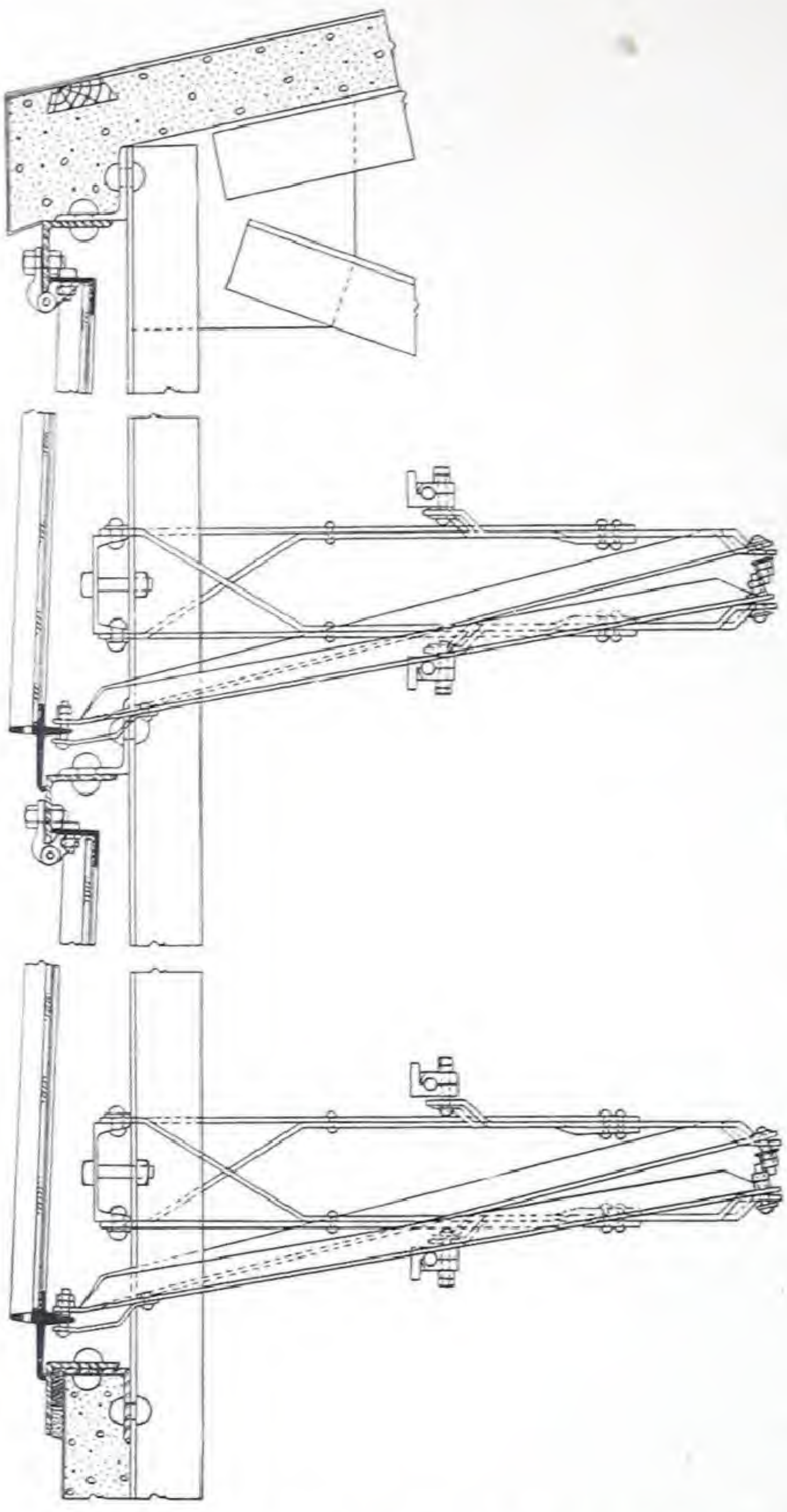


Welded joints and hinge of Pond Continuous Sash. The sections are shortened for greater clearness.



Rolled sections used in Pond Continuous Sash, with dimensions. Scale about one-half size.

Not only are rain and snow prevented from blowing over the top of sash so hung, but this exclusion of wind, as well as rain, is of the utmost value when the sash is used over a ventilating outlet, as in a Pond Truss roof or ordinary monitor. The inability of centre-



Pond Continuous Sash, 2-high, applied to vertical surface. The continuous angle at top of each sash prevents weather from entering. Sill members are provided with drip holes. Sill members are formed to make a point contact with sill for greater weather tightness.

pivoted sash to prevent a cross wind from entering is one reason why old-style monitors so generally fail to ventilate; the other reasons being that the peaked form of roof does not force the rising air to the outlets, and that the usual roof slope tends to carry a cross wind directly into the monitor.

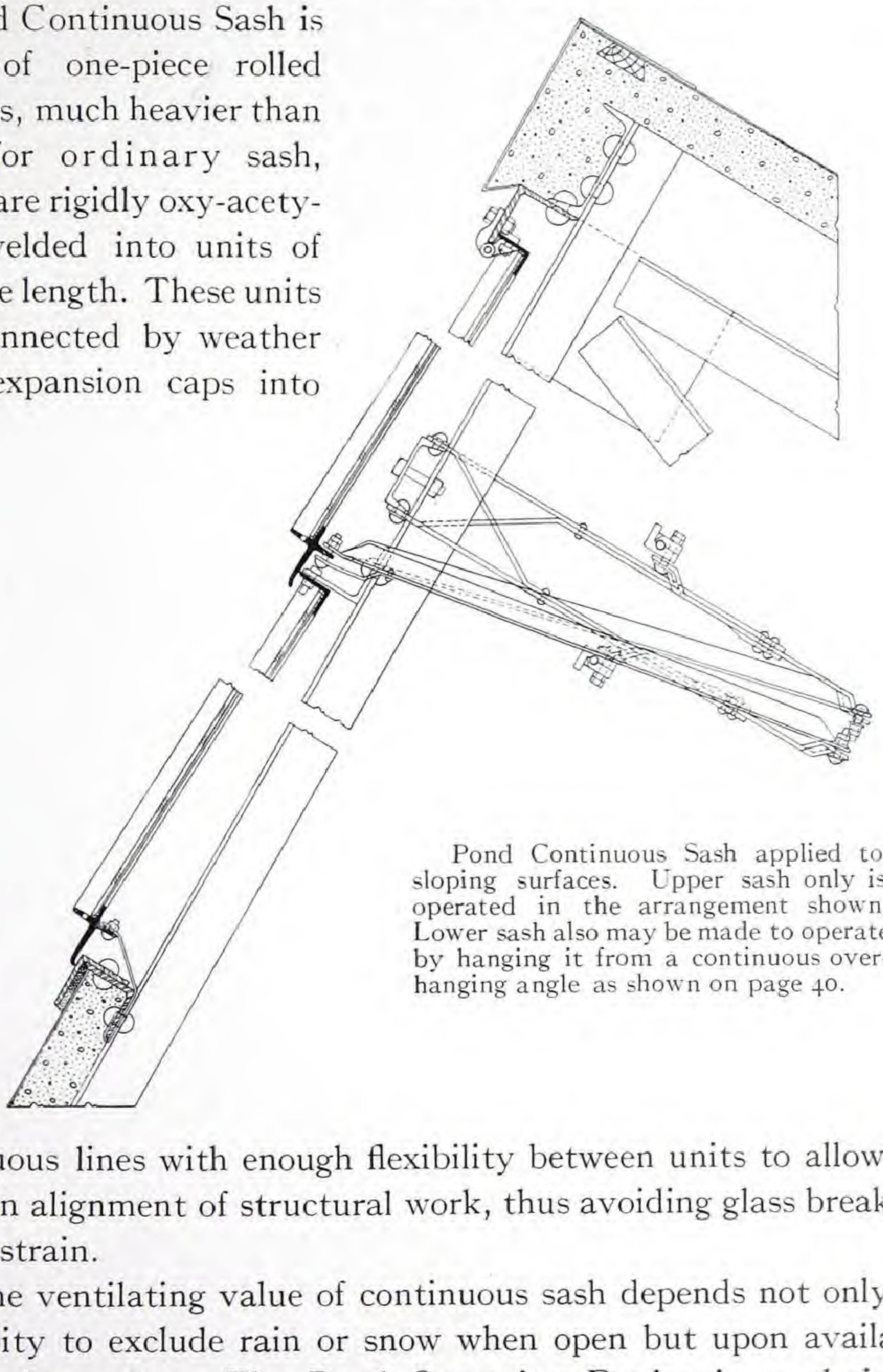
The wide opening of the sash is obtained by the use of Pond Operating Device, described on pages 42 to 44. This device, from its low friction and graduated thrust against the sash, will open the latter wider with less applied force than any other device.

The control of ventilating outlets and inlets of large area, such as long lines of sash in foundries and large factories, or groups of sawtooth sash like those of Goodrich Building No. 40 (pages 11 to 16) is accomplished by balancing the weight of the sash, and by electric motors. In this manner lines or

See the storm panels at end of sash, pages 28 and 29.

groups of indefinite extent may be controlled by a single motor, and the ventilation regulated to any degree desired.

Pond Continuous Sash is made of one-piece rolled sections, much heavier than used for ordinary sash, which are rigidly oxy-acetylene welded into units of suitable length. These units are connected by weather proof expansion caps into continuous lines with enough flexibility between units to allow for errors in alignment of structural work, thus avoiding glass breakage due to strain.



Pond Continuous Sash applied to sloping surfaces. Upper sash only is operated in the arrangement shown. Lower sash also may be made to operate by hanging it from a continuous overhanging angle as shown on page 40.

The ventilating value of continuous sash depends not only on its ability to exclude rain or snow when open but upon available width of opening. The Pond Operating Device is so designed as to give a wider opening with less applied force than any other

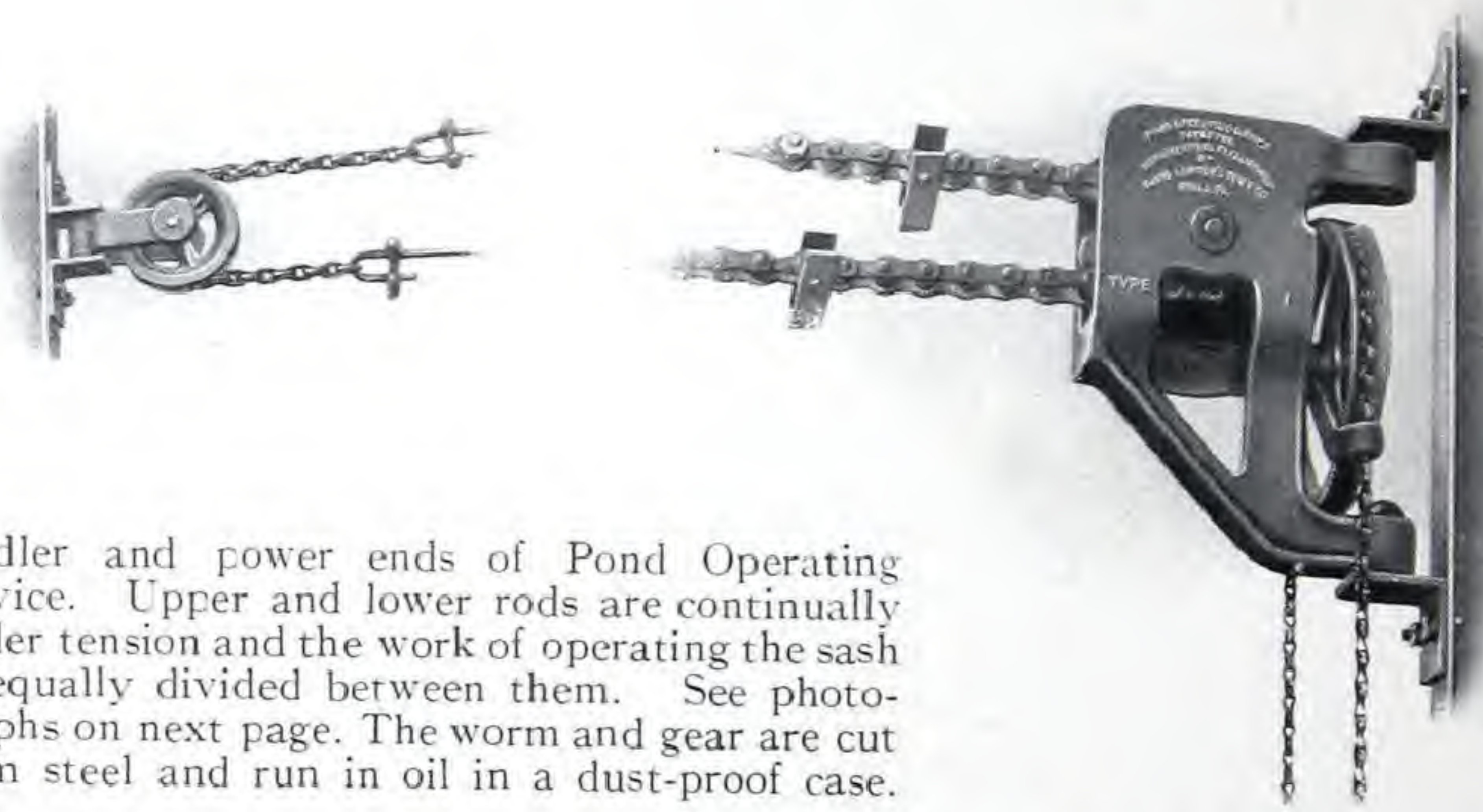
device made. We guarantee the following table of sash openings for the different heights of sash:

No. 3 sash, 3 ft. high, 45° or 26¾ in.
No. 4 sash, 4 ft. high, 45° or 35⅞ in.
No. 5 sash, 5 ft. high, 41° or 40⅞ in.
No. 6 sash, 6 ft. high, 36° or 44 in.

Pond Operating Device

The Pond Operating Device is especially designed to operate long lines of continuous sash.

A hand chain operates a worm and gear, from which lengthwise motion is imparted by a sprocket to a pair of tension rods, connected

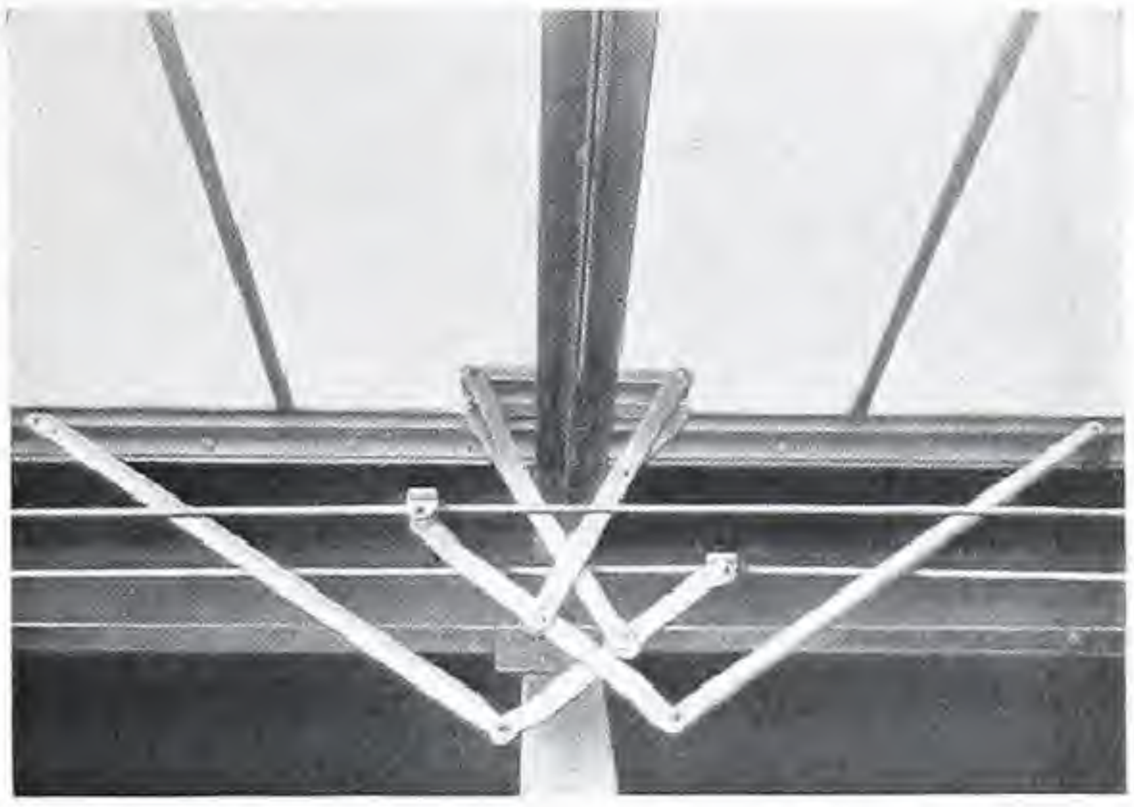


Idler and power ends of Pond Operating Device. Upper and lower rods are continually under tension and the work of operating the sash is equally divided between them. See photographs on next page. The worm and gear are cut from steel and run in oil in a dust-proof case.

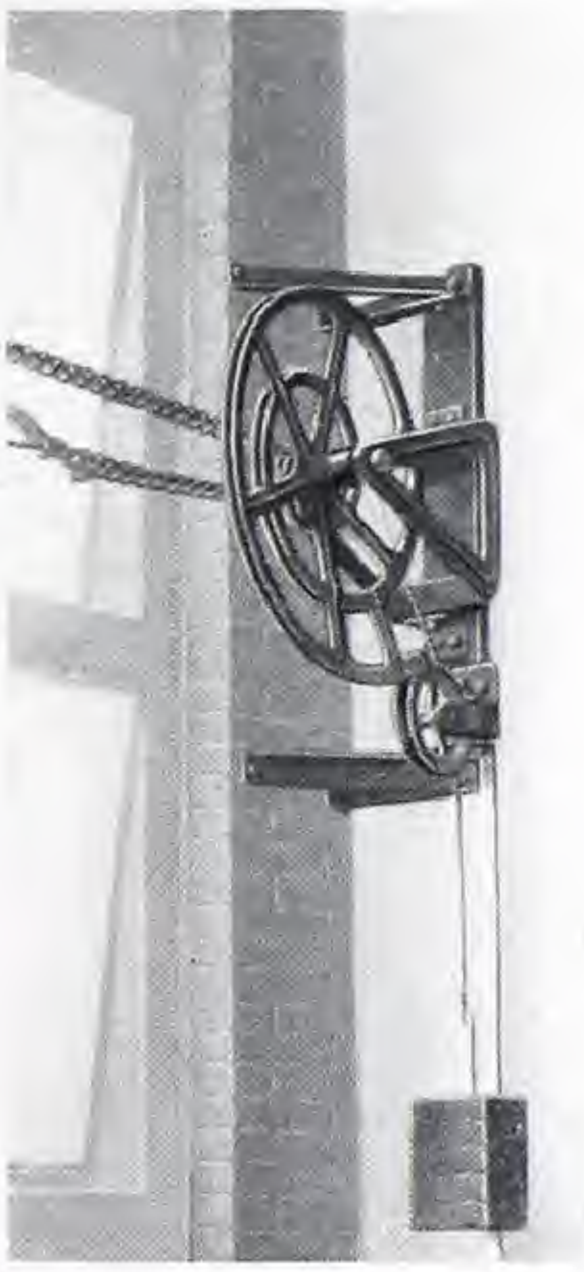
at their far ends to a chain running over an idler. To these rods are attached compound lever arms exerting a thrust against the lower member of the sash. This thrust is angular at first but increasingly direct as the sash is raised, hence the lifting effort is most effective when the greatest weight is overcome.

The rods are always in tension, and the load is divided equally between them as shown in the three views showing the sash from shut to open. This principle of tension transmission, with balanced thrust against the sash, largely accounts for the extremely low friction of the device.

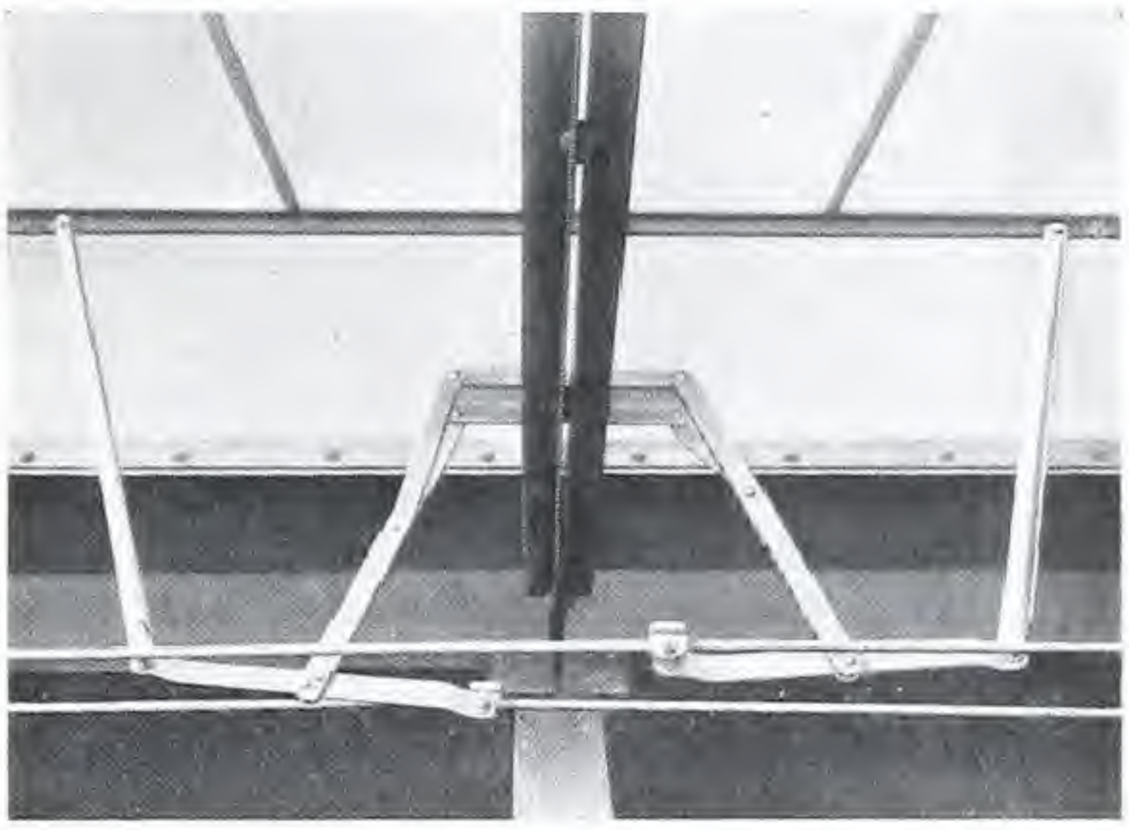
The worm and gear are accurately cut from steel and are enclosed in a dust-proof and oil-tight case. The hinged connections of the lever arms are bushed with phosphor bronze.



Compound levers of Pond Operating Device, showing position with sash closed.

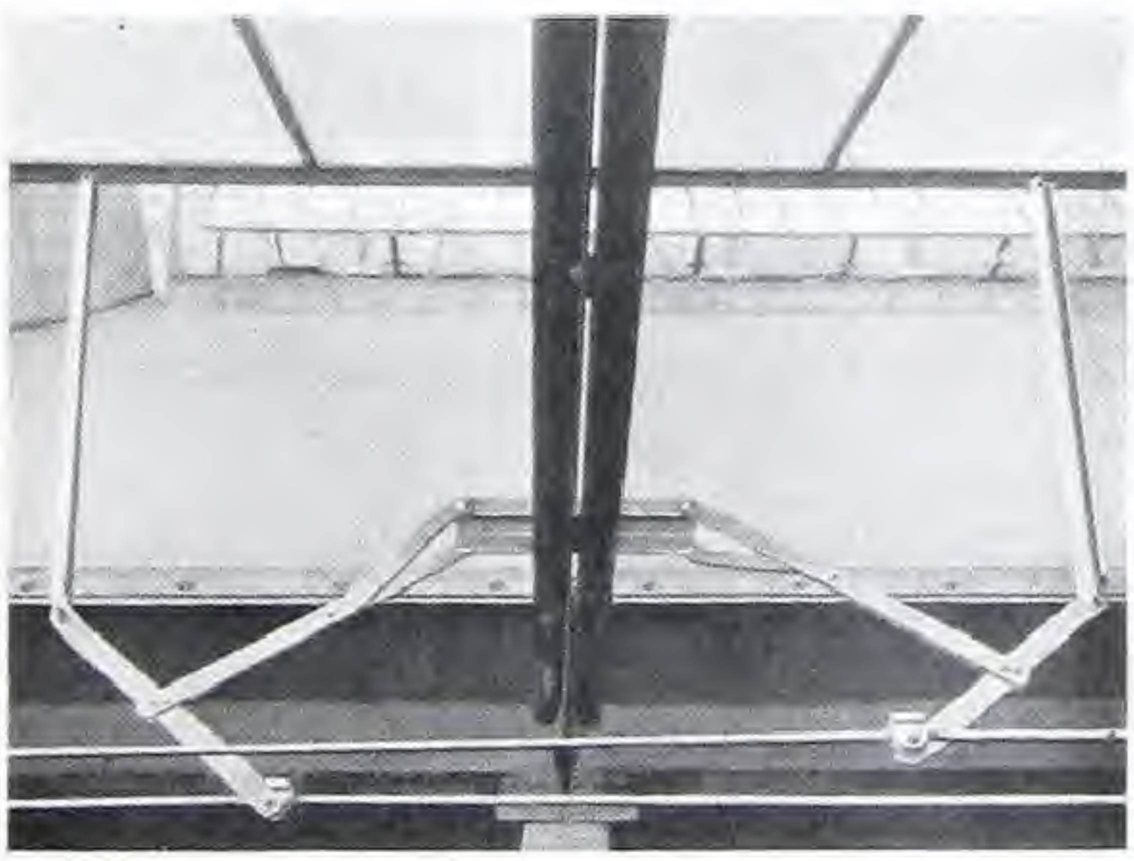


Spiral and counterweight used in place of idler for long lines of sash.



Sash partly open. The T-shaped levers are attached one to each tension rod.

For vertical lines longer than 100 ft. or sloping lines longer than 50 ft., spirals and counterweights should be used in place of idlers at the ends of the lines. These apply a force sufficient to balance the weight of the sash, leaving only friction to be overcome by the hand chain.



Sash fully opened. The tension of the rod is converted into a direct thrust against the sash.

For unusually long lines, or to operate a number of lines together, we recommend Pond Operating Device, Motor Driven. This embodies an A. C. motor specially wound for high starting torque. An automatic cut-out limits the movement of the sash in each direction, and the sash may be controlled by the switch to stand at any degree of opening desired.

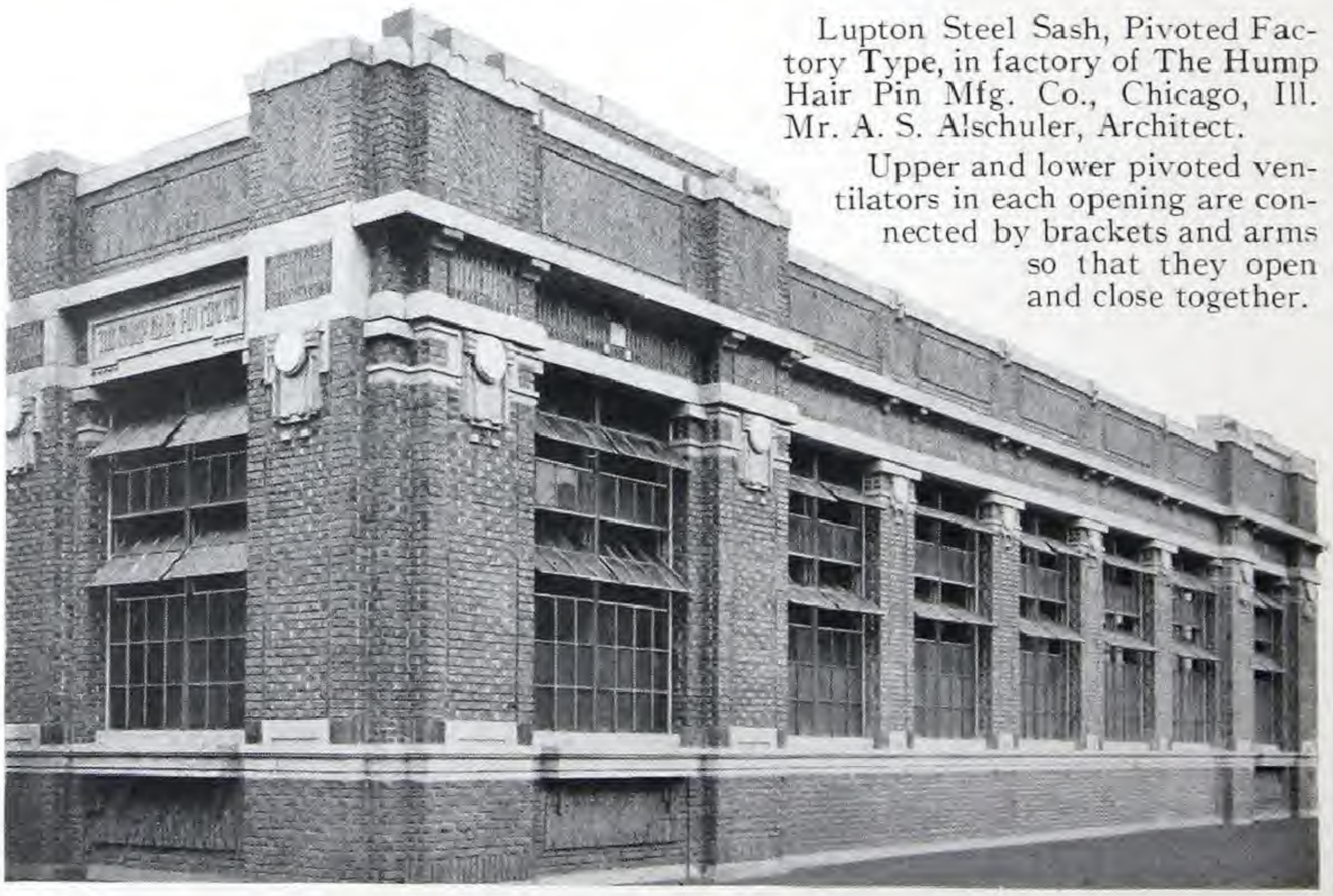
Enclosed gearing and electric motor of Pond Operating Device. Motor Driven.

Lupton Steel Sash, Pivoted Factory Type

This is a superior type of pivoted-ventilator sash, which is used with entire satisfaction in factories where the ventilating requirements are not exacting. It is both stronger and more durable than the cheaper types of pivoted sash usually offered.

Lupton Steel Sash, Pivoted Factory Type, in factory of The Hump Hair Pin Mfg. Co., Chicago, Ill. Mr. A. S. Alschuler, Architect.

Upper and lower pivoted ventilators in each opening are connected by brackets and arms so that they open and close together.



Have you a foundry, forge shop or power house?

ORIGINAL SASH DESIGNS

We were the originators of every type of modern rolled steel industrial sash, with the exception of the pivoted ventilator type, which was first made in England and Germany. Until we introduced the use of rolled steel sections, all counterbalanced and counterweighted windows were made of sheet metal or wood, with wide light-obstructing mullions and muntins; and continuous sash was not used at all. All the other types of sash named below were first introduced by us, together with certain others used in hospitals, schools and libraries and in power houses. Some of the features which we introduced have since been imitated elsewhere, while others can only be secured in Lupton Products.

Counterbalanced Steel Sash

Lupton Counterbalanced Sash was the first steel sash made with solid rolled sections and oyx-acetylene welded joints.

The following detail features were first used by us:

One-piece meeting rails; continuous heads and sills (in openings up to 25 ft. wide) to minimize corrosion; double rise of sill, with bottom rail to match; bronze weathering in mullions when ordered.

Counterweighted Steel Sash

Lupton Counterweighted Sash was the first of its type with solid rolled steel sections and welded joints.

Other features above noted are common to both counterbalanced and counterweighted Lupton Sash. Bronze weathering in mullions is standard for this sash.

Continuous Steel Sash

The idea of a continuous weather-proof lighting and ventilating opening was first commercially embodied in Pond Continuous Sash. Both top-hung and center pivoted types originated with us. Top-hung Pond Continuous Sash was the first to embody the following features:

Underlapping storm panels at ends; weather-proof expansion joint to connect sections; oxy-acetylene welded joints.

We do not recommend the center pivoted type, owing to its inferior ventilation, its lack of weather-protection and the higher cost of supporting steel work.

Pond Operating Device

The general design of the Pond Operating Device is patented. It is the only effective operating device for long lines of top-hung sash, and is the first embodying the following features:

Tension transmission, eliminating friction; T-shaped levers hinged to the building structure, the horizontal transmission rods, and the sash rods, in such a manner as to increase the leverage as the load of sash increases; bronze bearings and immersed gears; machine-cut gears; spiral and counterweight to balance load of sash; electric motor drive.

Lupton Pivoted Sash

The following details are original with us:

Solid one-piece muntins with flush joints; straight-line double weathering on ventilators; adjustable bracket arms and connecting bars at both sides of upper and lower ventilators, ensuring tight closing of upper ventilators; double-weathered ventilator pivot.

Pond Truss and Pond A-Frame

These designs are original with us. They cover the most practical methods yet invented of combining natural lighting with weather-proof openings for natural change ot air. The Pond Truss design is patented: We license its use in consideration of the exclusive use of Lupton Products in buildings so designed.

See page 46 regarding special booklets.

POND TRUSS FOR FOUNDRIES AND FORGE SHOPS

The Pond Truss type of roof was first designed by us to meet the exceptional ventilating and lighting requirements of large foundries, and was first applied in the foundries of the General Electric Co., at Erie, Pa. It is now very largely used for foundries, forge shops, glass factories and other establishments where large amounts of heat and fumes require to be quickly dispersed.

We have published a booklet entitled "Air and Light in Foundries and Forge Shops," which describes a number of modern buildings of this type. A copy will be sent free on request.

AIR AND LIGHT IN POWER HOUSES

Most large boiler rooms are dark and hot for the same reason—unscientific roof design. It is entirely practicable to design the roof of even the largest power station so that it will admit light and discharge heated air through lines of constantly-open continuous sash located just above the top of the boilers but below the side walls of the overhead bunkers. That is the basic feature of the Pond Truss, Power House Type, used in the Lake St. Power House, Cleveland, to light and ventilate a boiler room of 54 boilers arranged in three double batteries. This power house is fully described, with several others, in our booklet, "Air and Light in Power Houses," sent free on request.